GENERAL INFORMATION

REGD. NO. M. 2799

PUBLIC LIBRARY
NOV 1 3 1956
DET

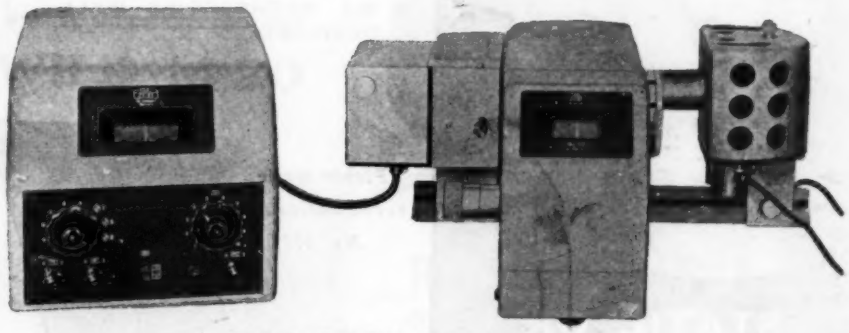
Current Science

Vol. 25, No. 9 SEPTEMBER 1956 Pages 277-311

CARL ZEISS

SPECTROPHOTOMETER

Mains-operated Model PMQ II



Made by Carl Zeiss, Oberkochen, Germany.

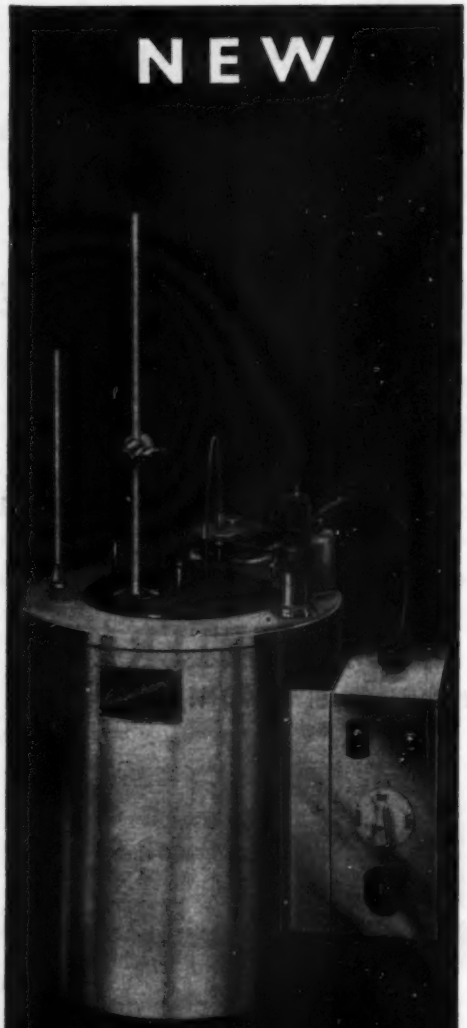
For precise measurements from 200 mμ in the ultraviolet to 1000 mμ in the near infrared region with high spectral resolution. Write for illustrated literature.

Sole Agents

ADAIR, DUTT & CO. (India) Private LTD.

CALCUTTA MADRAS BOMBAY NEW DELHI

NEW



STATIC OR ISOTHERMAL WATER-JACKET

GALLENKAMP

Advanced design

BOMB CALORIMETERS

FOR THE DETERMINATION OF CALORIFIC VALUE OF COAL, COKE AND OTHER FUELS AND FOODSTUFFS

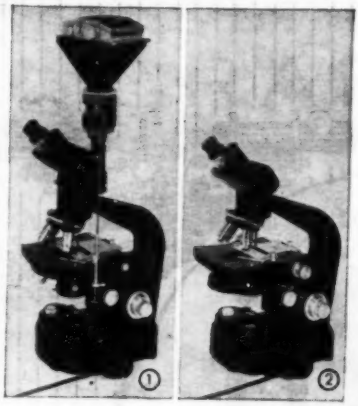
- IN ACCORDANCE WITH VARIOUS STANDARD METHODS INCLUDING BS 1016 AND IP 12/56 T
- EASILY OPERATED—NO TOOLS REQUIRED
- BOMB HAS LARGE SAFETY FACTOR
- CONVENIENT AND ACCURATE CALORIMETER
- ALL ACCESSORIES WELL DESIGNED

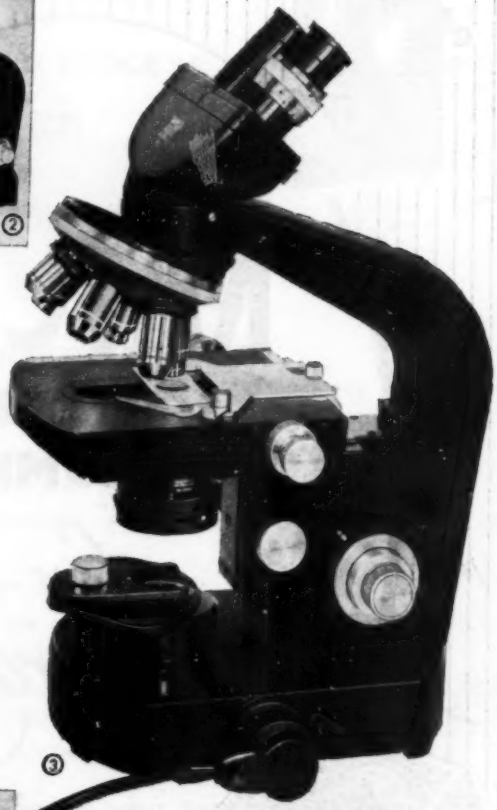
Please write for Publication No. 573

A. GALLENKAMP & Co., Ltd.
SUN STREET, LONDON, EC. 2

Accredited Agents in India
MARTIN & HARRIS (Private) LTD.
(SCIENTIFIC DEPARTMENT)
SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

WILD
HEERBRUGG

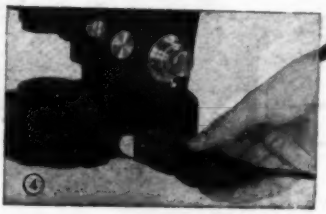




* The most COMPLETE Microscope so far made

* Ideal for QUALITY PRECISION & VARIETY

WILD M 20



The M 20 Microscope with few of its attachments

Fig. 1 : With Micro Camera and Binocular Tube;
Fig. 2 : Equipped as Phase Contrast Microscope ;
Fig. 3 : With Six-Hole Nosepiece ; Filter ,Exchanger, etc.
Fig. 4 : Built-in Illuminator for Kohler Illumination.

Sole Agents:

RAJ-DER-KAR & CO.

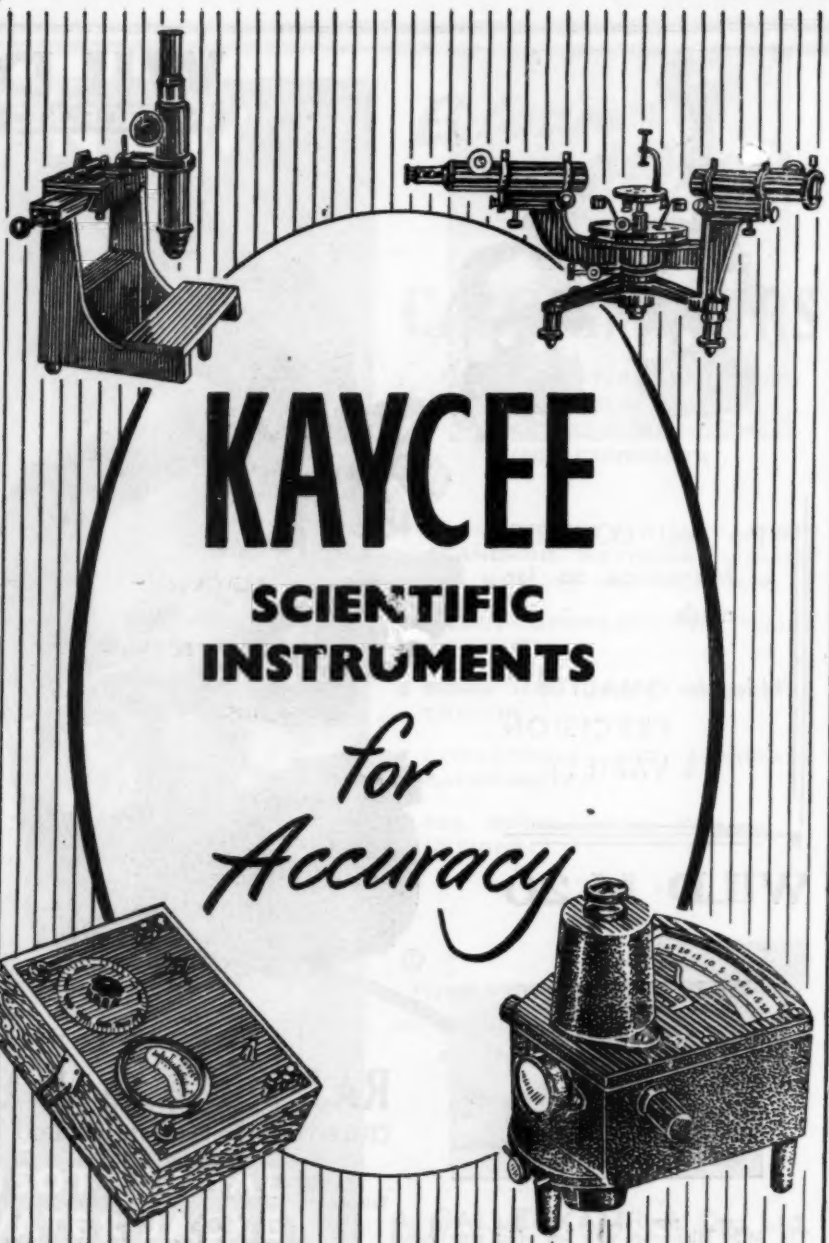
COMMISSARIATE BUILDING, HORNBY ROAD
BOMBAY-1

Telephone : 26-2304 Telegram : TECHLAB

Our Sub Agents:

The Central Scientific Supplies Co., Ltd.
No. 2, Agaram Road, Tambaram, Madras

The Upper India Scientific Works
Merigate, Delhi



KAYCEE

SCIENTIFIC INSTRUMENTS

for Accuracy

RADIO LAMP WORKS LTD.

Head Office:

Mahatma Gandhi Road, Bombay

Sales Offices at:

BOMBAY, CALCUTTA, DELHI, KANPUR, MADRAS, INDORE.

CRAFTSMAN

A SYMBOL OF QUALITY AND SERVICE

—FOR—

LABORATORY AND PROCESS CONTROL EQUIPS

CRAFTSMAN OFFER

- A COMPLETE RANGE OF PHOTOELECTRIC COLORIMETERS FOR CLINICAL, METALLURGICAL & BIOCHEMICAL COLORIMETRY
- OVENS & INCUBATORS, LABORATORY FURNACES, LABORATORY PYROMETERS, THERMOSTATS, ETC., BUILT BY CRAFTSMAN
- BOMB COLORIMETERS, EQUIPMENT & APPARATUS FOR OIL & CEMENT LABORATORIES
- L. & N. POTENTIOMETERS & GALVANOMETERS
- CAMBRIDGE PYROMETERS, pH METERS, SPOT GALVANOMETERS, D'ARSONVAL GALVANOMETERS, THERMOCOUPLES, POTENTIOMETERS, ETC.
- W. G. PYE'S POTENTIOMETERS, SCALAMP GALVANOMETERS, FLUX METERS, MICROSCOPES & KOHLRAUSCHES BRIDGE FOR CONDUCTIVITY MEASUREMENTS
- PHOTOVOLT pH METERS & COLORIMETERS

All ex-stock — no waiting for import licences and supply delays

ADDRESS YOUR INQUIRIES TO

CRAFTSMAN ELECTRONIC CORPN. (PRIVATE) LTD.

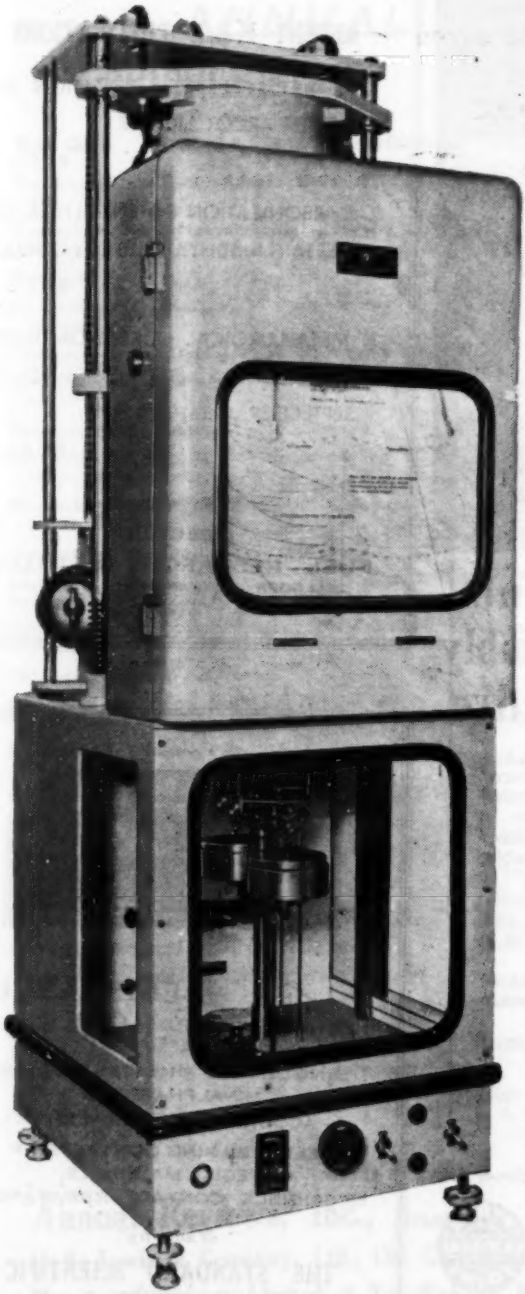
Laboratory, Factory & Office

SETHNA HALL, NESBIT ROAD, MAZAGAON, BOMBAY 10

Phone : 42346

Short List of Institutions and other Purchasers
OF THE
STANTON RECORDING THERMO-BALANCE

Atomic Energy Research Establishment	HARWELL, U.K.
Atomic Weapons Research Establishment	ALDERMASTON, U.K.
Safety in Mines Research Establishment	SHEFFIELD, U.K.
School of Mines, Adelaide	AUSTRALIA
European Research Laboratories, Brussels	BELGIUM
Admiralty Materials Laboratory (Three Instruments)	POOLE, U.K.
Dept. of Industrial & Scientific Research, Fuel Research Establishment	GREENWICH, U.K.
College of Technology	MANCHESTER, U.K.
Royal School of Mines	LONDON
University of the South-West of England	EXETER, U.K.
University of Glasgow	U.K.
University College	LONDON
University of Toronto	CANADA
University of Leyden	HOLLAND
University of Padua	ITALY
University of Munich	GERMANY
N. V. Phillips Eindhoven	HOLLAND
Royal Dutch Shell N. V. Amsterdam	HOLLAND
Institute Superieur da Sanitat, Rome	ITALY



STANTON RECORDING THERMO-BALANCE

FOR

CONTINUOUS

AND

SIMULTANEOUS

RECORDING

OF

TEMPERATURE

WEIGHT

AND

TIME

Made by

Stanton Instruments Ltd.

LONDON

Sole Agents

Martin & Harris (Private) Ltd.

Savoy Chambers, Wallace Street

BOMBAY 1

'PYREX' 'Grip-Seal' Joints simplify apparatus assembly ... are 100 per cent effective

The perfect-fitting qualities of 'Grip-Seal' Joints are due to the unique 'PYREX' method of manufacture, which ensures that every joint, both male and female, is ground and tested with micrometric precision.

Further, 'Grip-Seal' design results in stronger joints, with sturdier walls, more robust beadings, and sensible parallel gripping surfaces.

The logical result is, of course, that apparatus assembly is simplified, because every joint fits closely and securely, while the clamps hold the apparatus in a firm, safe grip.

Breakages in assembling and dismantling seldom occur, and expensive apparatus is thus safeguarded to give longer service.

That's typically 'PYREX' of course ... one hundred per cent satisfaction.

● *A special section of the 'PYREX' catalogue deals with 'Grip-Seal' apparatus. If you would like a copy, please send your name, address and position in firm or organisation.*

MADE IN J.P. PYREX J.P. ENGLAND

'PYREX'

REGD. TRADE MARK BRAND

'PYREX' GRIP-SEAL JOINT

THE BRITISH LABORATORY GLASSWARE

JAMES A JOBLING & CO LTD

Wear Glass Works Sunderland England

THE ONLY MAKERS OF 'PYREX' BRAND GLASS IN THE UNITED KINGDOM

RECENT F.R.I. PUBLICATIONS

1. REPORT ON THE UTILIZATION OF SOUTH ARCOT LIGNITE

   Rs. 5/-

2. CARBONIZATION POTENTIALITIES OF CERTAIN MADHYA PRADESH COALS

   Rs. 5/-

3. METALLURGICAL COKE FROM RANIGANJ COALS (TO BE ISSUED IN SEPTEMBER 1956)

   Rs. 5/-

Available from:

DIRECTOR

FUEL RESEARCH INSTITUTE

JEALGORA MANBHUM BIHAR

STANDARD

RESISTANCE BOXES

SINGLE AND MULTIPLE DIALS
MINALPHA COILS
ACCURACY 0·1 PER CENT.
SELF-CLEANING CONTACTS OF SPECIAL MATERIALS.
NEGLIGIBLE CONTACT RESISTANCE.

Made by

THE STANDARD SCIENTIFIC INSTRUMENTS Co.

115, BRODIES ROAD, MADRAS 28

ANNUAL REVIEW OF

BIOCHEMISTRY

Vol. 25 **July 1956**

Prefatory Chapter—Sir Edward Mellanby, *B. S. Platt*

Nonoxidative and Nonproteolytic Enzymes, *A. Meister*

Proteolytic Enzymes, *J. S. Fruton and M. J. Mycek*

Carbohydrate Chemistry, *E. J. Bourne and R. Stephens*

Chemistry of the Lipides, *F. B. Shorland*

Metabolism of Purines and Pyrimidines, *C. E. Carter*

Biochemistry of Viruses, *F. W. Putnam*

Metabolism of Lipides, *S. Bergström and B. Borgström*

Biochemistry of Cellular Particles, *W. C. Schneider and G. Hogeboom*

Chemistry of the Fungi, *H. Raistrick and C. E. Stickings*

Biological Oxidations, *S. F. Velick*

Chemistry of Proteins and Peptides, *H. Fraenkel-Conrat*

The Hemoglobins, *H. A. Itano*

Metabolism of Amino Acids and Proteins, *E. A. Adelberg and M. Rabinovitz*

Water-Soluble Vitamins, Part I, *J. J. Pfiffner and O. D. Bird*

Water-Soluble Vitamins, Part II, *E. E. Snell and D. E. Metzler*

Water-Soluble Vitamins, Part III, *G. W. E. Plaut and J. J. Bethell*

Fat-Soluble Vitamins, *E. Kodicek*

Nutrition, *W. H. Griffith and M. E. Swendseid*

The Biochemistry of Cancer, *C. Heidelberger*

Cholesterol Metabolism, *M. Friedman, S. O. Byers and S. St. George*

Chemical Constitution and Immunological Specificity, *M. Heidelberger*

Metabolism of Drugs and Other Organic Substances, *W. H. Fishman*

Carbohydrate Metabolism, *S. Korkes*

794 pages

PHYSICAL CHEMISTRY

Vol. 7 **September 1956**

Thermochemistry and Thermodynamics of Substances, *C. W. Beckett, H. W. Woolley and M. S. Green*

Cryogenics, *A. H. Cooke, R. Berman and R. W. Hill*

Heterogeneous Equilibria and Phase Diagrams, *J. M. Smith and J. W. Tierney*

Solutions of Nonelectrolytes, *R. L. Scott*

Statistical Mechanics, *J. E. Kilpatrick*

The Solid State, *L. Slifkin, F. J. Blatt and C. T. Tomizuka*

Isotopes, *K. Cohn and J. Silverman*

Magnetic Resonance, *C. A. Hutchison, Jr.*

Radiation Chemistry, *S. C. Lind and C. J. Hochanadel*

Quantum Theory, *W. Moffitt and C. J. Ballhausen*

Ion Exchange, *H. C. Thomas and G. Frysinger*

Polymers, *A. Tobolsky*

Surface Chemistry and Catalysis, *L. H. Reyerson*

Kinetics of Reactions in Solution, *R. M. Noyes*

Kinetics of Reactions in Gases, *G. Porter*

Molecular Electronic Spectroscopy, *M. Kasha and S. P. McGlynn*

Vibration-rotation Spectroscopy, *R. S. Halford and I. Ichishima*

Experimental Molecular Structure, *S. Mizushima and T. Shimanouchi*

Combustion and Flames, *C. E. H. Bawn and C. F. H. Tipper*

High Temperature Chemistry, *L. Brewer and A. Searcy*

Approx. 475 pages

each $ 7.50 postpaid

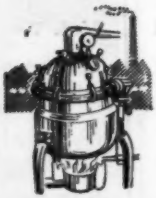
Annual Reviews, Inc., Grant Ave., Palo Alto, Calif., U.S.A.

H. K. Lewis & Company, Ltd., 136, Gower Street, London, W.C. 1, ENGLAND

Maruzen Company, Limited, 6 Tori-Nichome Nihonbashi, Tokyo, JAPAN

GAS PLANT

FOR LABORATORY, INDUSTRY & KITCHEN



Installed at :

Several important Laboratories, *viz.*, Central Drug Research Institute, Lucknow, Central Salt Research Institute, Bhavnagar, Central Road Research Institute, Delhi, Indian Institute of Technology, Kharagpur, Ahmedabad Medical College and Armed Forces Medical College, besides 20 units in Travancore-Cochin, 12 in Andhra, 6 in Madhya Pradesh recently totalling about 300 installations all over India.

Also makers of superior laboratory fittings & equipment

GANSONS (PRIVATE) LTD.

P.B. No. 5576, BOMBAY 14

TEMPO LABORATORY EQUIPMENT

Construction: Double-walled mild steel construction with 2" gap between the walls filled with fibre glass. Outside finished in silver-grey hammered tone synthetic enamel and inside painted with heat-resisting aluminium paint.

Size: (working space) 14" × 14" × 14"

Heating: Electrically operated on 230 V. 50 cycle, A.C./D.C.

Maximum Temperature: 250° C.

Temperature control: by means of a bimetallic thermostat. Variation not more than ± 1° C.

HOT AIR OVEN

Manufactured by:

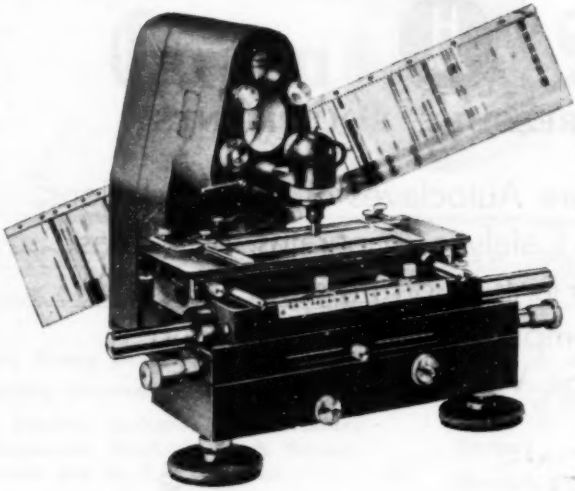
TEMPO INDUSTRIAL CORPORATION (PRIVATE) LTD.

1st Floor, Devkaran Mansion, Princess Street, BOMBAY 2

CURR. SCI., SEPTEMBER 1956

ZEISS

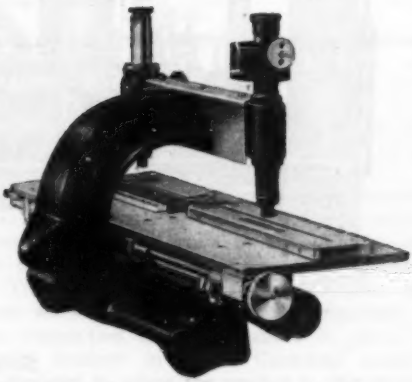
ZEISS RAPID PHOTOMETER



RAPID PHOTOMETER for the reliable and immediate evaluation of spectra by the photo-electric method

ABBE COMPARATOR

ABBE COMPARATOR for the precision measurement of spectrograms and other minute lengths and linear graduations Reading direct to 1/1000th of millimeter and estimating to 1/0000th mm. Measuring range 20 cm.



VEB CARL ZEISS JENA

Sole Agents of VEB CARL ZEISS JENA in India

GORDHANDAS DESAI & COMPANY

PHEROZESHAH MEHTA ROAD, BOMBAY 1

Telegrams : MICROSCOPY

Branches:

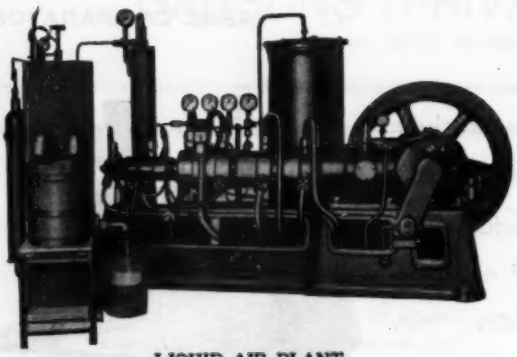
22, Linghi Chetty Street
MADRAS

P-7, Mission Row Extension
CALCUTTA

ANDREAS HOFER, GERMANY

HIGH PRESSURE EQUIPMENTS

Like High Pressure Autoclaves of various designs, High Pressure Catalytic Apparatus, Air & Gas Liquefying Plants, High Pressure Gas or Liquid Compressors, Gas Circulating Pumps, Valves, Fittings, Etc.



LIQUID AIR PLANT

Air or Gas liquefying plant, stationary or transportable type, complete with high pressure compressor, air liquefier and glass or metallic Dewar storage vessels. The plants can be supplied for capacities of 1·25 to 14 litres per hour.

Sole Agents :

TOSHNIWAL BROTHERS (PRIVATE) LIMITED

198, Jamshedji Tata Road
FORT, BOMBAY-1

Branch:
3/7, Mutiny Memorial Road
NEW DELHI 1

Branch:
9, Blacker's Road
Mount Road
MADRAS 2

Current Science

Vol. XXV] SEPTEMBER 1956 [No. 9

	PAGE
Atomic Energy Development in India ..	277
Expanding Universe	278
Fast Neutron Radiation and Localised Chromosome Breakage—M. S. SWAMINATHAN AND A. T. NATARAJAN ..	279
Synchronous Micronuclear Divisions in Multimicronucleate Ciliates—B. R. SESHACHAR AND P. B. PADMAVATHI ..	281
Dr. L. A. Ramdas	283
Letters to the Editor	284
Reviews	305
Chemical Applications of Spectroscopy—R. S. KRISHNAN	308
Science Notes and News	309

ATOMIC ENERGY DEVELOPMENT IN INDIA*

THE Geneva Conference on the Peaceful Uses of Atomic Energy was a most significant event for the scientifically less advanced countries, for it has made it possible for them to make progress in this field with very much less effort and expense than has been required of the more advanced countries during the last fifteen years. We owe a great debt to those countries which so wholeheartedly placed before this Conference the knowledge which they had gained through such strenuous efforts and at such great cost.

The Indian programme in the field of atomic energy, modest as it is, has made considerable progress during last year. The planning of the Atomic Energy Establishment at Trombay has been completed and construction work has started. The capacity of the thorium plant has been increased several fold, and a plant for producing natural fuel elements for future reactors is being set up. The first atomic reactor of the swimming pool type became critical on August 4, and is now undergoing its trial runs.

A reactor of the NRX type was generously offered by Canada last year, and the modifications which would have to be made to allow for the difference in environmental conditions of Trombay and Chalk River (Canada) have been worked out and are being finalised. In this connection it is a pleasure to recall the hearty manner in which Canadian scientists co-operated to adapt the reactor to the changed environment and improve it for research and other purposes. A location for the reactor in Trombay has been decided upon and excavation, foundation and building work are in progress.

A formal agreement between the Governments of Canada and India was signed in New Delhi in April of this year, under which Canada will make available the reactor proper, while India will be responsible for its erection and provision of the associated laboratory.

The reactor will be housed in a hermetically sealed steel shell, so that in case of accidents

* Summary of a broadcast talk from the A.I.R. in the field of Atomic Energy given by Dr. H. J. Bhabha, Director, Atomic Energy Establishment.

radioactivity does not leak into the atmosphere. The reactor is expected to go into operation in the first half of 1958, and in the spirit in which the reactor has been offered, India will make the facilities of this reactor available for the use and benefit of scientists from other countries in Asia and beyond. The heavy water for the reactor has been made available by the United States, without any conditions being attached, except that it should be used only in connection with research for peaceful purposes, a condition which is readily acceptable.

It may be mentioned that studies have been completed for the construction of a large fertilizer plant where substantial quantities of heavy water may be made as a by-product, and construction work on the project will start shortly. The possibility of making heavy water at the large Government-owned fertilizer plant at Sindri has been investigated, and a decision to make heavy water there will be taken shortly. The circumstance that India requires large amounts of ammonium sulphate or nitrate as fertiliser, coupled with the fact that substantial quantities of this fertiliser will be produced in State-owned plants offers possibilities for producing considerable quantities of heavy water as a by-product.

It may be added that India is an active member of the International Atomic Energy Agency mooted by President Eisenhover at the end of the Geneva Conference last year, and participated in a working level meeting in Washington to prepare a draft Statute for the Agency. This draft Statute is to be considered by an International Conference of some 80 countries to be held in New York in September this year. A number of problems on which there were considerable differences of opinion seem to have been satisfactorily solved at the Washington meeting, and it is expected that those that remain will be ironed out in the New York Conference.

Ending on a serious note, which is readily understandable in view of the political and economic implications of atomic energy, Bhabha observes: "The matter which causes India and many other States very considerable concern is the severity and far-reaching nature of the Article relating to Safeguards. Precautions against misuse are naturally necessary and must be taken. But they must be approached in a spirit of reality. The proposed safeguards requiring accountability for the source materials, uranium and thorium, when supplied by the Agency, in a world in which thousands of tons of these materials are sold from one country to another, avowedly for use in military programmes, are clearly unfair and arouse the fear in many that the result, if not the intention, will be to create a uranium cartel. Fissionable material will be the future fuel for electric power generation in the world, and to require such material to be turned over to the Agency by countries receiving aid is to give the Agency power to interfere in the economic life of such countries. We must not let fear and suspicion and an illusory hope of making a foolproof system drive us into the position where the main purpose of setting up the Agency is throttled. But there is no doubt that if the International Agency is approached with the same courage, vision and trust, as the Atomic Energy Conference in Geneva last year, we shall have taken a most important step towards establishing a secure peace and a rich and prosperous future for mankind."

EXPANDING UNIVERSE

SUBSTANTIAL new evidence that the universe is expanding at the same rate in all directions has been obtained in a recently completed 20-year co-operative study by astronomers at the Mount Wilson-Palomar Observatories and the University of California's Lick Observatory. The conclusions are derived from the red-shifts of more than 800 extra-galactic nebulæ, or galaxies, in the universe beyond the Milky Way.

When interpreted as velocities of recession, red-shifts provide the observational material for relativity theories of the expanding universe. So far, uniform expansion of the universe has been inferred from relatively few observations of red-shifts, for adequate experimental data have not been available prior to the completion of the present study, which consequently is of fundamental importance in astronomy.

A report has been published in the *Astronomical Journal* by M. L. Humason and A. R. Sandage of the Mount Wilson-Palomar Observatories, and N. U. Mayall of Lick Observatory. The programme to determine red-shifts was formulated in 1935 by the late Edwin Hubble.

FAST NEUTRON RADIATION AND LOCALISED CHROMOSOME BREAKAGE

M. S. SWAMINATHAN AND A. T. NATARAJAN

Indian Agricultural Research Institute, New Delhi

IT is of interest while studying the cytological effects of radiations to determine whether breaks occur at random in the chromosomes, or whether certain points are specially liable to be broken. Such studies can be carried out only in favourable material where certain chromosomes can be marked and their division cycle separately followed. Ford *et al.*[1] have recently used chromosome markers in the study of the problem of regeneration of particular groups of cells in mice. The present paper deals with certain observations on the effects of fast neutron radiation on mitosis in root tip cells of *Triticum monococcum* (var. Japanese Early) using a pair of satellited chromosomes as markers.

Dry seeds of *T. monococcum* were irradiated for 3 hours with fast neutrons of source strength 10^9 neutrons/cm.^{2}/sec. (approx.) over a 2π solid angle from the cascade generator of the Tata Institute of Fundamental Research, Bombay, using the reaction $d(Be^9 B^{10})\alpha$. The seeds were germinated in petri dishes at 24° C. and the effects of the treatment on somatic chromosome division were studied in Feulgen root tip squashes of material fixed in acetic alcohol (1 : 3) without any pre-treatment 24, 72 and 96 hours after germination. Preparations from untreated *T. monococcum* seeds germinated and fixed in a similar way, served as controls.

The control preparations showed the normal division figures characteristic of *T. monococcum*. In the material treated with neutrons, cell division proceeded without inhibition. At prophase and metaphase of the dividing nuclei, many chromosome breaks and interchanges were seen. Other cytological aberrations included the presence of bridges and fragments at anaphase and micronuclei at telophase and formation of occasional polyploid nuclei. Some cells showed clumping at metaphase and bridges at anaphase due to a surface stickiness caused by the deposition of nucleic acid on chromosomes in a fluid unpolymerized state.

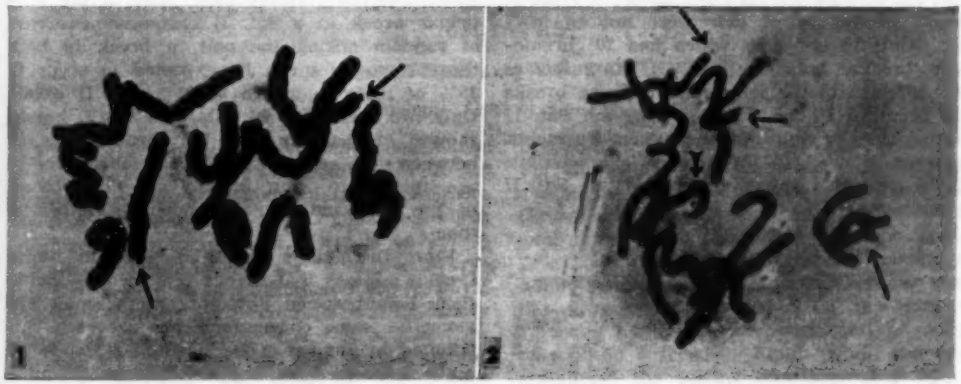


FIG. 1. A normal somatic complement of *T. monococcum* ($2n = 14$). Arrows point to Sat. II pair which have been used as markers in this study. FIG. 2. Neutron treated root tip cell showing 3 Sat. chromosomes intact (→) and one Sat. II chromosome broken near the supernumerary constriction region in the short arm (↦). (Magnification of photographs, × 1800.)

In the normal chromosome complement of *T. monococcum*, there are two pairs of satellite-bearing chromosomes, one of which is somewhat longer than the other (designated Sat-chromosome I and II; relative lengths 12·6 μ and 10·4 μ respectively). Among the remaining five pairs of chromosomes, the centromere is submedian in position in 4 pairs and median in the other. In the short arm of the satellited chromosomes, there is a weak supernumerary constriction. These chromosomes are readily recognisable in well-spread plates (Fig. 1) and hence were used as markers in the following study.

Only chromosome breaks occurred at metaphase and no chromatid breaks could be identified. The frequency of occurrence of chromosome breakages was analysed in 315 metaphase plates; in 210 of these, no breaks were seen and in the rest the number of breaks per cell varied from 1 to 20. The relative frequency with which cells containing different numbers of breaks were found, follows Poisson distribution thus indicating that the formation of a chromosome break is unaffected by the presence or absence of other breaks in the cell.

In preparations made from material fixed 24 hours after germination, a critical study of the types and points of origin of breaks could be done in 64 clear metaphase plates. The analysis showed that a break frequently occurred near the supernumerary constriction region of one chromosome belonging to the Sat. II pair (Fig. 2). The frequency of occurrence of this particular break and the total number of breaks observed in different cells are listed in Table I. Breaks in the Sat. I pair were noticed in 7 cells. Only in two cells which had 20 chromosome breaks, both the Sat. II chromosomes were affected in the same region. Some breaks also occurred in the distal part of the Sat. II chromosomes. None of the other fragments, however, showed the recurrence characteristic of the proximal break in one of the Sat. II chromosomes.

TABLE I

Description	No. of cells	No. of localised breaks in Sat. II	Total No. of breaks
Regular ..	11	0	0
One chromosome break ..	20	9	20
Two chromosome breaks ..	21	12	42
Three do ..	5	2	15
Four do ..	2	1	8
Five do ..	2	1	10
Six do ..	1	1	6
Twenty do ..	2	4	40
TOTAL ..	64	30	141

The total chromosome length in a somatic complement of *T. monococcum* was calculated to be 172·2 μ, of which the length of the Sat. II pair was 20·8 μ. If chromosome breakages following neutron radiation are caused completely at random, the chances for any one of the observed breaks to occur in the Sat. II chromosomes will be proportional to their length in the complement. On this basis, approximately one in every 8·3 breaks could occur in the Sat. II chromosomes. The observed figure of 30 out of a total of 141 breaks does not, however, fit with this expectation ($\chi^2 = 11{\cdot}30$; $P < 0{\cdot}01$). This would suggest that the region near the supernumerary constriction of Sat. II chromosomes is preferentially disposed to breakage by neutron radiation. There was no evidence in preparations made 24, 72 and 96 hours after germination of the occurrence of a general restitution, and hence the results may not be attributable to non-random reunion and restitution of broken fragments instead of to non-random breakage. It is not possible to determine by microscopical observations whether the breakage always occurs only in one particular chromosome of the Sat. II pair. The occurrence of a single Sat. II break in most of the cells suggests that some degree of differentiation with reference to localised neutron sensitivity may occur in the apparently homologous pair of chromosomes. Also, if the particular break in a Sat. II chromosome occurs at random among the pair, a break in both the chromosomes can be expected to occur in 25% of the cells which show a Sat. II break. Only two among the 28 cells with Sat. II breaks showed breakage in both the chromosomes (P between 0·05 and 0·02). Thus, localised breakage appears to occur in only one chromosome of the pair and not at random in either of them.

From the results so far reported in literature, it appears that breaks produced by radiations both between different chromosomes and along the same chromosome are generally distributed at random. The position is, however, quite different with regard to chemical mutagens. Observations by Ford[2] and others in *Vicia faba* have clearly shown that the heterochromatic regions of chromosomes are more susceptible to damage by radiomimetic chemicals like Nitrogen Mustard than the euchromatic parts. There are indications that the heterochromatic regions of chromosomes may also be more sensitive to breakage induced by radiation with X-rays, ultraviolet rays and gamma rays.[3,4]

In both slow and fast neutron irradiated material, chromosome breaks have usually been assumed to occur at random. Konzak and Singleton[5] have, however, very recently found that different endosperm factors in chromosome 9 of maize respond quite differently to thermal neutron radiation, thus indicating some basic difference in the breakability of chromosomal regions. The results of the present study provide for the first time cytologi-

cal evidence for the existence of a non-random sensitivity of chromosome segments to fast neutron action. Examination of chromosomes in root tip cells subjected to cold treatment did not reveal the presence of any prominent heterochromatic segment in the region where breakage frequently occurs. In case the non-random breakage is confined to only one of the Sat. II chromosome pair, as seems likely from our data, it may suggest the presence of a submicroscopic differentiation between the homologous pair of chromosomes at the vulnerable region. In a similar study carried out in the same variety of *T. monococcum* using β radiation from ^{32}P, we found no evidence for a preferential susceptibility to breakage of any segment in either Sat. II or the other chromosomes. Thus, it would appear that the localised breakage caused by fast neutron radiation is probably a correlated consequence of the specific properties of the neutron particles and the concerned chromosome segment.

We are indebted to Dr. B. P. Pal and Dr. S. M. Sikka for their interest and advice. We are very grateful to the Tata Institute of Fundamental Research, Bombay, and Dr. R. Ramanna for irradiating the seeds with neutrons.

1. Ford, C. E., Hamerton, J. L., Barnes, D. W. H. and Loutit, J. F., *Nature*, 1956, **177**, 452.
2. Ford, C. E., *Proc. 8th International Genetic Cong. Hereditas Suppl.*, 1949, 570.
3. Barton, D. W., *Cytologia*, 1954, **19**, 157.
4. Moutschen, J. and Govaerts, J., *Nature*, 1953, **172**, 350.
5. Konzak, C. F. and Singleton, W. R., *Proc. Nat. Acad. Sci.*, 1956, **42**, 78.

SYNCHRONOUS MICRONUCLEAR DIVISIONS IN MULTIMICRONUCLEATE CILIATES

B. R. SESHACHAR AND P. B. PADMAVATHI

Dept. of Zoology, Central College, Bangalore

BINARY fission is a recognizable phenomenon in the life-cycle of all protozoa, where the nucleus as well as the cytoplasm divide more or less simultaneously. In all euciliates where nuclear dimorphism occurs, there is an amitotic macronuclear system and a mitotic micronuclear system. In multimicronucleate forms the behaviour of the micronuclei during binary fission is very striking. There is synchronous division of all the micronuclei in the system. Similar examples are presented by d'Arcy Thompson[1] and Sonnenblick[2] in the fertilized insect egg where synchronization of nuclear divisions is seen for many generations. Apparently chemical situations identical throughout a syncytium induce nuclear divisions.[3] Such a type of synchrony is induced under experimental conditions by Darlington and Mc Leish[4] in the endosperm cells after X-radiation. Intermittent heat treatment to cultures of *Tetrahymena* resulted in synchronous cell division.[5] Apparently enzymatic processes operating in the cell system are highly sensitive to temperature change, producing widely different responses. Such induced chemical disturbances acting on cell metabolites must lead to synchronous cell division.[6]

Frontonia leucas is a multimicronucleate ciliate where, under normal laboratory conditions, all the micronuclei divide synchronously preparatory to cell division. Fig. 1 shows all the micronuclei in telophase. An essentially similar but less striking phenomenon is seen in *Oxytricha bifaria* where also the micronuclei exhibit a striking synchrony in their divisions (Fig. 2). On the other hand, in *Spirostomum ambiguum*, another multimicronucleate ciliate, the situation is different. Of the numerous (often a hundred) micronuclei in the animal, only 20-30 proceed to divide while the others remain in the resting condition (Fig. 3). It would be worthwhile to know the kind of selectivity responsible for the initiation of division in only a few micronuclei in *Spirostomum*.

In *Frontonia* and *Oxytricha*, there is harmony between synthesis and cell division. On the contrary, the fertilized egg represents an extreme case of competition between synthesis and cell division. In the ovary there is no division, only synthesis; but once fertilization occurs, synthesis is completely suppressed in the ovum and the emphasis is on the cell division which takes place in rapid succession. In its normal cell cycle, every growing and dividing cell switches to and from these two extremes of cell phenomena. The situation is altered by external agents like chemicals in the medium[7] or temperature.[5] But in *Frontonia* the stimulus for synchronous nuclear division is internal even as in

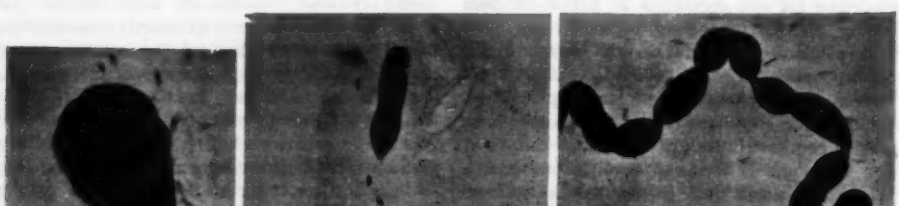


FIG. 1. Part of *Frontonia leucas* showing synchronous division of the micronuclei. The macronucleus shows a constriction. Feulgen, × 1,000.

FIG. 2. *Oxytricha bifaria* showing synchronous division in the four micronuclei. Feulgen, × 1,000.

FIG. 3. Part of *Spirostomum ambiguum* showing ten micronuclei in the "crescent" stage. A few micronuclei in the resting condition are also found. The macronuclear beads are coming together preparatory to fission. Feulgen, × 1,000.

Spirostomum the selectivity must be due to a cytoplasmic chemodifferentiation.[8] These cytological events must be mere expressions of more deep-seated biochemical mechanisms under the guidance of either external stimuli[4,5] or internal stimuli as in *Frontonia*, *Oxytricha* and *Spirostomum* and the insect egg.[1,2] Only these internal stimuli may be of more than one kind, manifesting itself now in synchrony (*Frontonia*, *Oxytricha*) and now in selectivity (*Spirostomum*). It seems entirely impossible to determine the nature of this stimulus. The physiological gradients of Hammerling,[9,10] the cytoplasmic chemodifferentiation hypothesis of Waddington,[8] the plasmagene-like factors of Spiegelman,[11] the physical intermolecular electronic hypothesis of Lwoff[12] or the kinetosome theory of Weisz[13] are only a few of the plausible explanations.

We need now to form some idea of the physiological processes in cells which underlie these phenomena. We are forced to picture some sort of a dynamic system responding to the environment, involving both the nucleus and the cytoplasm, or an interaction of nuclear and cytoplasmic cyclical dependency as described by Waddington.[8]

1. Thompson, d'Arcy, W., *On Growth and Form*, 1942, Cambridge University Press.
2. Sonnenblick, B. P., *In the Biology of Drosophila*, edited by Demerec, 1950, John Wiley and Sons, New York.
3. Hotchkiss, R. D., *Proc. Nat. Acad. Sci.*, 1954, **40**, 49.
4. Darlington, C. D. and Mc Leish, *Heredity*, 1954, **8**, 385.
5. Zeuthen, E. and Scherbaum, O., *In Recent Developments in Cell Physiology*, 1954, edited by J. A. Kitching, (Butterworth, London).
6. Ephrussi, B., *Nucleocytoplasmic Relations in Microorganisms*, 1953, Oxford University Press.
7. Darlington, C. D. and Koller, P. C., *Heredity*, 1947, **1**, 187.
8. Waddington, C. H., *Symp. Soc. Exp. Biol.*, 1948, **2**, 145.
9. Haemmerling, J., *Arch. Entomech. Org.*, 1934 *a*, **131**, 1.
10. —, *Ibid.*, 1934 *b*, **132**, 424.
11. Spiegelman, S., *Cold. Spr. Harb. Symp. Quant. Biol.*, 1951, **16**, 87.
12. Lwoff, A., *Problems of Morphogenesis in Ciliates*, 1954, J. Wiley & Sons, New York.
13. Weisz, P. B., *Quart. Rev. Biol.* 1954, **29**, 207.

DR. L. A. RAMDAS

DR. L. A. RAMDAS, Deputy Director-General of Observatories (Climatology and Geophysics), retires from the India Meteorological Department on superannuation on 3rd October 1956. Dr. Ramdas began his career as a Palit Research Scholar from 1923-26 under Sir C. V. Raman and discovered the phenomenon of the 'Scattering of Light by Pure Liquid and Sound Surface'. He conducted several fundamental investigations on surface phenomena, scattering of light by gases and other optical phenomena. He was awarded the Doctorate Degree in Physics of the Calcutta University. He was the first to obtain in 1928 the 'Raman Effect' in the case of a vapour (ether vapour).

He joined the India Meteorological Department in September 1926 and spent his first five years in the then fresh field of Aviation Meteorology and researches in Micro-climatology, a hitherto unexplored subject.

In 1932, when the Indian Council of Agricultural Research inaugurated the Scheme of Agricultural Meteorology, an entirely unexplored field of research of the greatest importance to Indian Agriculture, Dr. Ramdas was chosen for the task of organising and developing the new Division of Agricultural Meteorology at the Meteorological Office, Poona. In this capacity he was actively engaged on fundamental researches in micro-climatology, crop-climates, heat and moisture balances near the ground, soil moisture, plant relationships, radiation balance near the ground, statistical researches into crop-weather relationships, and work on many borderland problems in physics, meteorology, soil physics, plant physiology, etc. The results of these many investigations have been discussed in a series of more than 250 original papers and reports which have won for India a leading place in the field of Agricultural Meteorology. They have been widely quoted or referred to in standard publications on the subject.

In 1953, Dr. Ramdas assumed charge of the post of Deputy Director-General of Observatories (Climatology and Geophysics) at the Meteorological Office, Poona, in which capacity he was in general charge of the Climatological, Geophysical and Agricultural Meteorological programmes of the India Meteorological Department. During the period 1953-56, he carried out interesting researches on various aspects of the South-West Monsoon, the winter depressions which affect the weather over North India during the winter season and the micro-climates of buildings. During this period, he officiated as the Head of the India Meteorological Department for a short period.

Dr. Ramdas has a high reputation in Indian scientific circles and is a prominent member in most of the scientific bodies in India related to Physics, including Atmospheric Physics and Agricultural Meteorology. He presided over the Physics Section of the Indian Science Congress at the Patna Session in 1948 and was awarded the M.B.E. by the previous (British) Government of India in 1946 for his pioneer researches in Agricultural Meteorology.

He is also a member of many International Bodies, some of which he has attended as Delegate and taken active part. He attended the Ninth Assembly of the International Union of Geodesy and Geophysics at Brussels in 1951 as the Chief Delegate of India. He is a member of the Radiation Commission of the IUGG since 1949. He attended the first session of the Agricultural Meteorology Commission of the World Meteorological Organisation held at Paris in 1953 and presided over the Committee which dealt with all technical and scientific items. He was a member of the Indian Delegation to the Pan Indian Ocean Science Congress held at Perth (West Australia) in August 1954, where he delivered two lectures on Long Range Forecasting and Micrometeorology respectively. He has been now invited by the UNESCO to take part in the forthcoming Symposium on Arid Zone Climatology with special reference to Micro-climatology to be held in Canberra (Australia) from 17th to the 24th October 1956.

Dr. Ramdas is primarily a physicist who has had always a band of Post-Graduate research students working under his guidance. He has also for the last 10 years carried out and continues even now advanced investigations in infra-red spectroscopy under a Research Scheme financed by the Council of Scientific and Industrial Research with the aid of two Research Assistants provided by the Council. We hope that he will be continuing his scientific work with undiminished enthusiasm and energy.

LETTERS TO THE EDITOR

	Page
Simultaneous Signal Strength Measurements on Continuous and Pulsed Radio Wave Transmissions Reflected from the Ionosphere—B. Ramachandra Rao and K. V. V. Ramana	284
Unit Cell and Space Group of Aluminium Acetylacetonate and Cobalt Acetylacetonate—P. G. Khubchandani	285
Slowing Down of Neutrons in Beryllium from 1·44 ev. to Thermal Energy—K. S. Singwi and L. S. Kothari ..	286
An Efficient Solubility Apparatus—G. Aravamudan and K. R. Krishnaswami	287
Preparation of Ceric Acetate in the Anhydrous State and Its Photo and Thermal Decompositions—D. Patnaik and S. Panda	287
Conversion of Histidine to Urocanic Acid in Germinating Seeds—V. M. Sivaramakrishnan and P. S. Sarma	288
Occurrence of Hæmagglutinins in Calf Vaccine Lymph—V. N. Krishnamurthy	289
Sickle Cell Trait in Some Tribes of Western India—P. K. Sukumaran, L. D. Sanghvi and G. N. Vyas	290
Anatomical Defects of the Reproductive Organs in Cattle Found in Uttar Pradesh—Mahendra Pratap Johari ..	291
Condition Factor in Some Fishes of Lucknow, Uttar Pradesh—S. K. Moitra ..	292
A Fermentation Process for the Production of Quality Fish Meal—V. Krishna Pillai	293
Pseudomonas tuticorinensis *N. Sp., A Marine Denitrifying Bacterium*—A. Sreenivasan and R. Venkataraman ..	294
Occurrence of Nodal Galls on Sugarcane—M. Q. Khan, D. V. Murthy and S. K. Sastry	295
Variations in the Development of Proembryo in Utricularia cœrulea *L.*—S. B. Kausik and M. V. S. Raju ..	296
A Male Sterile Mutant in N. tabacum—N. R. Bhat and T. Krishnamoorthi ..	297
A New Bacterial Leaf-Spot on Phaseolus trilobus—V. V. Bhatt, S. G. Abhyankar and M. K. Patel	299
Pythium catenulatum *Matthews Causing Sugarcane Seedling Root Rot*—K. V. Srinivasan	299
Spontaneous Variegated Chimæra in Dianthus chinensis *L.*—C. M. Bastia and G. Panigrahi	300
A Thermostatically Controlled Miniature Glass-House—T. S. Sadasivan, (Miss) L. Saraswathi-Devi and (Miss) C. B. Sulochana	301
Soil Application of 2, 4-D to Increase Sugar in Cane—A. S. Chacravarti, D. P. Srivastava and K. L. Khanna ..	302
Nematode Galls on a Grass Dicanthium annulatum—D. Bap Reddy	303
Metamict Hematite—M. D. Karkhanavala	303
A Large Overthrust Structure Near Debipur (Barakar), West Bengal—D. N. Rath, S. Ramaratnam and S. B. Kar ..	304

SIMULTANEOUS SIGNAL STRENGTH MEASUREMENTS ON CONTINUOUS AND PULSED RADIO WAVE TRANSMISSIONS REFLECTED FROM THE IONOSPHERE

Rawer[1] compared noon-time ionospheric absorption data at two stations, Freiburg and Slough, 400 Km. apart, for a period of 26 months and observed that the mean amplitudes obtained at the two stations vary similarly. Subsequently Beynon and Davies[2] conducted a series of experiments in one of which they compared the day to day changes in the intensity of the signals received from distant short wave broadcast senders and vertical incidence ionospheric signals from a pulse transmitter radiating on an equivalent frequency. They observed that, in general, there is a quite close correlation between the monthly mean values of the two signals, the correlation coefficient obtained in summer being smaller due to sporadic E ionisation. No attempt has been made so far to study the extent of correlation between the short time variation of pulse and CW signals extending over a day. The authors have taken up the comparative study of the signal strength variations of oblique incidence CW and vertical incidence pulse signals over a short period of about an hour during afternoon every day with a view to find out the extent of correlation existing between them.

The experimental technique adopted in this investigation is conventional. Transmissions from A.I.R. station at Madras radiating on a frequency of 9·54 Mc/s. on the short-wave band have been chosen for obtaining the CW field strength records on an Esterline Angus pen recorder. The vertical incidence signal strength records were taken on a conventional ionospheric sounding equipment consisting of a pulse transmitter and receiver operating on a frequency of 3·15 Mc/s. which is the equivalent vertical incidence frequency for reflections from the E layer at a height of 110 Km. It is observed that during the period of recording the operating frequency is always lower than the critical frequency of the E layer. A good number of records taken during the months of May and June in the afternoon hours were analysed statistically for finding out the correlation coefficient between the signal strength variations in the two records. The pulse signal strength records were taken on single hop reflections from the E region. The following table gives the values of the correlation coefficients thus obtained for six typical days, along with the date and duration of the record.

TABLE I

Sl. No.	Date	Duration of the record	Correlation coefficient
1	21–5–1955	1630 to 1651	0·61
2	24–5–1955	1621 to 1644	0·45
3	2–6–1955	1627 to 1659	0·51
4	14–6–1955	1600 to 1632	0·27
5	22–6–1955	1605 to 1632	0·54
6	27–6–1955	1602 to 1630	0·61

It will be seen that the average coefficient is as high as 0·5. To illustrate the extent of correlation visually a graph is drawn showing the variation of mean signal strengths of pulsed and continuous radio waves with time for a record taken on 21-5-1955 and is reproduced in Fig. 1. The general similarity between these curves shows that the major absorption which occurs in the lower D-layer is also responsible for the short time variations in the signal strength. The general trend of increase in the signal strength in both the records towards evening is due to the decrease in the D-layer absorption. It is significant to note that the average correlation coefficient obtained here is higher than that reported by Beynon and Davies for summer months in spite of the high activity of sporadic E at this place during these months. Further work is in progress.

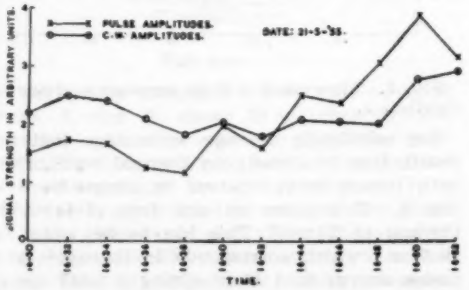


FIG. 1

Ionospheric Res. Labs., B. RAMACHANDRA RAO.
Andhra University, K. V. V. RAMANA.
Waltair, *June* 20, 1956.

1. Rawer, K., *J. Atmos. Terr. Phys.*, 1951, **2**, 38.
2. Beynon, W. J. G. and Davies, K., *Ibid.*, 1954, **5**, 273.

UNIT CELL AND SPACE GROUP OF ALUMINIUM ACETYLACETONATE AND COBALT ACETYLACETONATE

ASTBURY[1] has taken rotation pictures of both aluminium acetylacetonate and cobalt acetylacetonate. He has determined the cell parameters of both to show the isomorphous nature of the monoclinic acetylacetonates.

During the course of other investigations in this Establishment, it became necessary to make an X-ray examination of the two acetylacetonates. The cell constants have been determined by rotation, followed by Weissenberg photographs and are given in Table I.

	Aluminium acetylacetonate	Cobalt acetylacetonate
a_0	13·88 Å	14·13 Å
b_0	7·53 Å	7·53 Å
c_0	16·14 Å	16·12 Å
β	98°30′	98°30′

The cell parameters determined here from Weissenberg photographs agree well with those reported by Astbury from rotation photographs. From the systematic absences in the $0\,k\,0$ and $h\,0\,l$ series, the space group for both has been confirmed to be $P2_1/c(C_{2h}^5)$.

Chemistry Division, P. G. KHUBCHANDANI.
Atomic Energy Establishment,
Bombay, *July* 16, 1956.

1. Astbury, W. T., *Proc. Roy. Soc.*, 1926, **112A**, 449.

SLOWING DOWN OF NEUTRONS IN BERYLLIUM FROM 1·44 ev. TO THERMAL ENERGY

THE slowing down age of neutrons in moderators like beryllium and graphite is calculated using Fermi's continuous slowing down theory which is only valid so long as the neutron energy is large compared with the binding and thermal excitation energies of the moderating nuclei. In the low energy region, Fermi's theory breaks down and has to be replaced by a quantum theory. Neutrons of energy greater than that corresponding to the Debye temperature of the moderator, lose their energy to the lattice by emitting multi-phonons. When the neutron energy is only slightly greater than the equilibrium energy, it slows down through processes in which both emission and absorption of phonons are important. The slowing down of neutrons in this energy region has not been satisfactorily studied so far. We report here some of the results of our calculations on the slowing down of neutrons in beryllium from 1·44 ev. to thermal energies. The details will be published elsewhere.

For neutron energy $E < 2\,k\Theta_D$, Θ_D being the Debye temperature (1,000° K for Be) and k, the Boltzman constant, we have used the Debye model of the solid to calculate the elastic and inelastic scattering cross-sections[1] and the mean logarithmic energy decrement ξ, as a function of neutron energy. The temperature of the moderator was taken as 300° K. On the Debye model it is very difficult to take account of processes in which more than 2 phonons are involved and as these higher order processes become important for neutron energy greater than about $k\Theta_D$, in this high energy region we have used the Einstein model of a solid (Einstein temperature $\Theta_E = 740°$ K) to calculate the scattering cross-sections and ξ. The two curves for ξ have been smoothly joined and values given by this curve have been used for further calculations. ξ goes to zero at $E = 600\,k$. Below this energy it is negative and tends to $-\infty$ as $E \to 0$. For energies greater than $600\,k$, ξ increases and attains a constant value of 0·2 for $E > 10{,}000\,k$. If we average this value of ξ over a Maxwell distribution we obtain a result which can be compared with experiment. The variation of the averaged ξ with the characteristic temperature T_0 of the neutron distribution is shown in Fig. 1. As expected $\bar{\xi}$ goes to zero at $T_0 = 300°$ K.

The neutron age can be calculated using the above value of $\bar{\xi}$. As in all idealised equilibrium problems, the age tends to infinity as neutrons approach equilibrium. To determine the neutron age by this method it is essential to take into account the absorption of neutrons in the moderator, and this problem will not be considered here.

FIG. 1. Mean logarithmic energy decrement averaged over Maxwell distribution, as a function of characteristic temperature of the distribution.

An alternative method for studying the slowing down of neutrons is to calculate the mean energy loss per collision as a function of neutron energy. After suitably averaging this over the Maxwell distribution, the time variation of the temperature of the neutron distribution can readily be calculated and this is shown in Fig. 2. According to the calculations, the distribution approaches equilibrium at 296° K with a relaxation time of 19 microseconds.

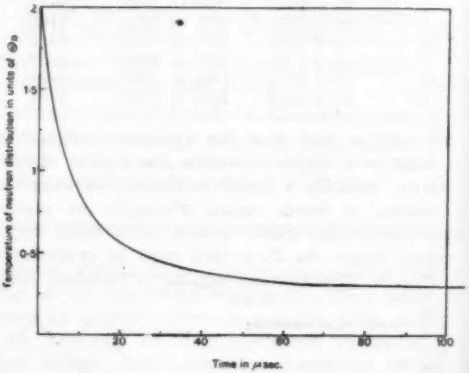


FIG. 2. Time variation of the temperature of neutron distribution.

For calculating the age we assume that the distribution is already in thermal equilibrium with the moderator when its temperature is 300° K. This gives an age from 1·44 ev. to thermal of 20 cm.^{2} This has to be added to 80·2 cm.^{2} which corresponds to the age^2 from fission energy to 1·44 ev, giving a total age of 100·2 cm.^{2} from fission energy to thermal. This

may be compared with the total experimental age[2] of 97·2 cm.[2]

The slowing down time from fission to 1·44 ev. is 13 μ sec., whereas the time spent by the neutron in slowing down from 1·44 ev. to thermal is 100 μ sec., giving the total slowing down time of 113 μ sec.

It would be interesting to verify experimentally the calculated variation of neutron temperature with time.

Atomic Energy Establishment, K. S. SINGWI.
Apollo Pier Road, L. S. KOTHARI.
Bombay-1, *July* 26, 1956.

1. Kothari, L. S. and Singwi, K. S., *Proc. Roy. Soc.*, *A*, 1955, **231**, 293.
2. Hughes, D. J., *Pile Neutron Research* (Addison-Wesley Pub. Co. Inc., Cambridge, Mass.), 1953, p. 125.

AN EFFICIENT SOLUBILITY APPARATUS

THE solubility apparatus used by us and shown in Fig. 1 is essentially a modification of the

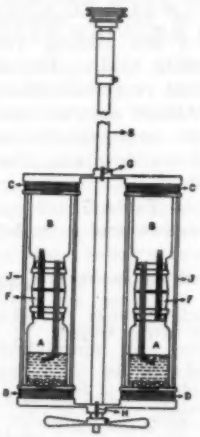


FIG. 1

one devised by Campbell.[1] Two wide-mouthed bottles A and B about 30 ml. capacity, are connected with each other by the filter gadget F. The filter device consists of two double-holed rubber bungs through which pass (1) a Pyrex tubing constricted at one end and plugged with glass-wool, and (2) a thick-walled 0·5 mm. glass capillary bent as shown in the figure. This arrangement is simpler, stronger and serves better than the glass-quill employed by Campbell. The bottles are held firmly by cork rings inside the water-tight glass jacket J. The jacket consists of the 2 mm. thick Pyrex glass tube to the ends of which are fixed screwed brass rings C and D provided with caps. This glass jacket prevents direct contact between the solubility bottles and the liquid of the thermostat. A pair of jackets can be clamped in position between sockets to the vertical shaft S by means of screws G and H. During equilibration, the entire assembly rotates with the stirrer at desired speeds.

Bottle A is charged with the solvent and excess of solute and rotated until equilibrium is reached. The glass jacket is then inverted, it being held inside the bath all the time. The saturated solution filters through the tube containing glass-wool from A to B, the air being displaced simultaneously from B to A through the capillary. The filtration thus occurs continuously at exactly the same temperature as that at which the saturated solution is prepared. The bottles B and A containing the saturated solution and the wet residue respectively are then removed from the jacket, covered with ground glass plates and weighed for subsequent analysis.

The size of the bottles and the fittings could be altered according to the quantities involved. The apparatus has been found to work smoothly under various conditions and has been used in these laboratories since the last twenty years.

Dept. of General Chem., G. ARAVAMUDAN.
Indian Inst. of Science, K. R. KRISHNASWAMI.
Bangalore, *July* 31, 1956.

1. Campbell, A. N., *J. Chem. Soc.*, 1930, 179.

PREPARATION OF CERIC ACETATE IN THE ANHYDROUS STATE AND ITS PHOTO AND THERMAL DECOMPOSITIONS

THE preparation of the cerous acetate in the anhydrous state has been reported.[1] Ceric acetate has not hitherto been isolated and is only known in solution.[2] We have separated ceric acetate in the anhydrous state by the reaction of cerous nitrate with a mixture of glacial acetic acid and acetic anhydride. The compound separated in well-defined crystals having garnet-red colour. The colour in the powder state is lemon-yellow. The compound is so prone to react with water that any trace of the latter would change the colour to white. Every precaution, therefore, had to be taken to

guard against moisture during its preparation, isolation and study of its reactions.

Cerium content of the compound was determined by ignition over a Teclu burner in tared platinum crucibles. The available combustion apparatus does not attain the decomposition temperature of the intermediate carbonate formed, thus preventing the direct estimation of carbon and hydrogen. Hence the alkali value, equivalent to the acetic acid formed by hydrolysis, was determined. The data recorded in Table I would show that the compound isolated is $Ce(CH_3COO)_4$.

TABLE I

Weight of compound	Weight of oxide		Weight of compound	Req. vol. of NaOH soln. calculated	1·002 N/10 in c.c. found
	Calculated	Found			
0·1812	0·0829	0·0820	..	..	..
0·1686	0·0771	0·0756	0·1082	11·49	11·65
0·2442	0·1118	0·1124	0·1432	15·31	14·90
0·1818	0·0836	0·0844	..	..	..

The compound is sensitive to light. Exposure to sunlight with exclusion of moisture results in the reduction to cerous state. The mechanism of this photo-decomposition and the identification of the products are under investigation. The thermal decomposition proceeds in a manner whereby the ceric state is essentially maintained. The details of the two processes of decomposition will be published in due course.

Dept. of Chemistry, Ravenshaw College, Cuttack, *July* 30, 1956.

D. PATNAIK.
S. PANDA.

1. Panda, S. and Patnaik, D., *J. Ind. Chem. Soc.* (to be published).
2. Newton Friend, J., *Text-Book of Inorganic Chemistry*, 2nd Edn., Charles Griffin Ltd., London, p. 403.

CONVERSION OF HISTIDINE TO UROCANIC ACID IN GERMINATING SEEDS

IN a previous communication[1] the conversion of histidine to glutamic acid or to an acid-labile derivative of glutamic acid in germinating greengram seeds (*Phaseolus radiatus*) was reported. The initial step in this conversion was shown to be the formation of urocanic acid by the deamination of histidine, in the case of animals[2] and bacteria.[3] Whether a similar conversion of histidine to urocanic acid takes place during the germination of greengram seeds has been investigated through the isotope-trapping technique and the results are reported here.

10 g. of greengram seeds, divided into two equal lots, were allowed to germinate in 11 cm. petri dishes for 72 hours. The medium in each dish contained 6·16 mg. of 2-C^{14}-labelled histidine with an activity equal to $2·048 \times 10^7$ c.p.m. and also 30 mg. of inert urocanic acid in 24 ml. of sterile water. The urocanic acid added to the medium served to trap any radioactive urocanic acid that might be formed during germination. Germination and sterility tests were carried out as described earlier.[4]

At the end of germination, the seedlings were ground and thoroughly extracted with water. The extract was deproteinised by heat-coagulation at pH 5·0. An aliquot of the extract was reserved for the estimation of urocanic acid by its intense absorption at 275 mμ and pH 7·0 in a Beckmann spectrophotometer.[5] To the remaining extract, 50 mg. urocanic acid was added as carrier and the solution concentrated *in vacuo*. The resulting brown syrupy solution was clarified by the addition of basic lead acetate solution, centrifuging off the precipitate and removing the excess lead with H_2S. The clear solution, on further concentration, pH adjustment to 4·6 and cooling yielded crude crystals of urocanic acid. The product was purified by several recrystallisations, until the fine needles obtained showed constant radioactivity. Activity measurements were carried out by the use of a flow gas counter as previously described.

TABLE I

Formation of urocanic acid from 2-C^{14}-histidine

Amount of radioactivity in the histidine added	$4·096 \times 10^7$ c.p.m.
Urocanic acid in the total extract ..	75 mg.
Urocanic acid in the extract taken for isolation	60 mg.
Urocanic acid added as carrier ..	50 mg.
Activity in sample (45 μg) of the uroconic acid isolated	473 c.p.m.
Therefore, radioactivity in urocanic acid in the total extract	$1·444 \times 10^6$ c.p.m.
Percentage of radioactivity in urocanic acid	3·53

From the results presented in Table I, it will be seen that urocanic acid contains an appreciable amount of radioactivity. Thus there is a significant synthesis of urocanic acid from histidine during germination of greengram seeds. The rate of metabolism of neither histidine nor urocanic acid during germination is known. As such it is difficult to assess the exact quantitative significance of this conversion. However, the conversion of histidine to gluta-

mic acid, through urocanic acid as an intermediate, is concluded to be the main pathway of histidine degradation in animals and in *Pseudomonas fluorescens*.[5] This conclusion is supported by the presence of active histidase in these organisms. But all attempts at establishing the presence of histidase in 72 hr-old germinating greengram seedlings have been unsuccessful, though homogenates as well as clear supernatants were tested through a wide range of pH values.

University Biochem. Laboratory, Madras-25, *August* 4, 1956.

V. M. SIVARAMAKRISHNAN.
P. S. SARMA.

1. Sivaramakrishnan, V. M. and Sarma, P. S., *Curr. Sci.*, 1955, **24**, 330.
2. Mehler, A. H. and Tabor, H., *J. Biol. Chem.*, 1953, **201**, 775.
3. Tabor, H., Mehler, A. H., Hayaishi, O. and White, J., *Ibid.*, 1952, **196**, 121.
4. Sivaramakrishnan, V. M. and Sarma, P. S., *Biochem. J.*, 1956, **62**, 132.
5. Tabor, H., in *A Symposium on Amino Acid Metabolism*, 1955, Ed. McElroy and Glass, The John Hopkins Press, p. 373.

OCCURRENCE OF HAEMAGGLUTININS IN CALF VACCINE LYMPH

VACCINIA HÆMAGGLUTININS have been studied in detail by many workers since Nagler[1] first described it of fowl red blood cells by material from vaccinal lesions on the chorioallantoic membrane of the egg. It is known that calf lymph conspicuously lacks this property. While Nagler[1] states that hæmagglutinins are absent from calf lymph, others[2,3] have suggested the possibility of their being present in a masked form. Evidence is presented in this paper that hæmagglutinins are produced in calf lymphs but masked by certain inhibitors. In the case of buffalo calf lymph, the inhibitor seems to be of the nature of an antibody. In the case of cow calf lymph, however, there seems to be some other inhibitors as well.

A large number of samples of buffalo calf lymph (fresh and old) were subjected to hæmagglutinin tests. While none of the fresh ones agglutinated the fowl blood cells, older samples (a year or more old) gave positive hæmagglutination reaction—the degree of reaction being proportional to the age of the calf lymph with maximal titration in 4 years or more old lymphs. This hæmagglutination was found to be specific as it could be neutralised only by its immune serum.

Fresh buffalo calf lymph possessing no hæmagglutinating property gave positive hæmagglutination reaction when subjected to heat at 80° C. for half an hour, indicating the presence of both the hæmagglutinins and heat sensitive inhibitors. Temperatures below 80° C. did not inactivate the inhibitor. Precipitation with ammonium sulphate (50% saturation) carried the inhibitor along with the precipitate and that too with the water-soluble portion. It is known that the antibodies against vaccinia hæmagglutinins in immune sera possess the same properties.[3]

Material from one- and two-day-old vaccinal lesions from buffalo calves show evidence of hæmagglutination, but the one from lesions older than two days did not agglutinate the fowl red blood cells without pretreatment with heat. The examination of sera from these calves, 6 hours, 24 hours, 2 days, 3 days, 4 days, 12 days and 15 days after vaccinia infection showed development of antihæmagglutinins in the blood 2 days after vaccination, synchronising with the non-hæmagglutination of fowl cells by material from vaccinal lesions older than 2 days. Gradual increase in titre was noted till the 12th day. It is clear from this that vaccinal lesions on the buffalo calf fail to agglutinate the fowl red blood cells only after the appearance of the antihæmagglutinins in the blood. Since chick embryos do not produce antibodies,[4] it is not surprising that the vaccinal lesions on chorioallantoic membrane of eggs do agglutinate the fowl red blood cells readily as there is no interfering antibody.

In the case of cow calf lymph, however, it was observed that the lymph at 80° C. for half an hour did not release the hæmagglutinins. It required boiling for 1 minute to observe the hæmagglutination phenomenon. Further, while old buffalo calf lymphs gave positive hæmagglutination reaction, old cow calf lymph (oldest was six years old) gave no evidence of hæmagglutination. Again precipitation with ammonium sulphate (50% saturation) did not completely remove the inhibitors. The nature of these inhibitors is being studied in detail.

The author is indebted to Dr. S. Seshagiri Rau, Director of Public Health, in Mysore, Bangalore, for his valuable support and advice during the study.

Vaccine Institute, Bangalore-2, *May* 9, 1956.

V. N. KRISHNAMURTHY.

1. Nagler, F. P. O., *Aust. J. Med.*, 1942, **1**, 281.
2. Stone, J. D. and Burnet, F. M., *Aust. J. Exp. Biol. Med. Sci.*, 1946, **24**, 9.
3. Chu, C. M., *J. Hyg. Camb.*, 1948, **46**, 49.
4. Burnet, F. M., Stone, J. D. and Edney, M., *Aust. J. Exp. Biol. Med. Sci.*, 1950, **28**, 29.

SICKLE-CELL TRAIT IN SOME TRIBES OF WESTERN INDIA

SICKLE-CELL trait or sicklæmia has been reported in Negroes in many parts of Africa and America. Recently this trait has been found to be present among the white people of the Mediterranean region (Greece, Italy, Sicily, Egypt and Turkey). In India, Lehmann and Cutbush[1] found sickle-cell trait among the aboriginal tribes of Nilgiri Hills. Büchi[2] has repeated this study and confirmed the finding. Dunlop and Mozumdar[3] reported cases of sickle-cell trait and some presumptive cases of sickle-cell anæmia among the tea garden labourers of Upper Assam, originating from the tribal populations of Orissa and Bihar. Foy *et al.*[4] examined 5,000 samples in Eastern and Southern India and have reported a large percentage of sickle-cell trait in some of the tribes examined by them in both these regions. They have not reported their findings in detail so far. Bhatia *et al.*[5] reported four cases of sickle-cell trait in a family of nine members of Danukh caste in Mainpuri District of Uttar Pradesh.

The purpose of the present communication is to report the incidence of sickle-cell trait among some tribes and castes of Western India. The tribal groups included Bhil, Dhodia, Dubla, Koli and Naika, selected by virtue of being the most numerous groups in Gujarat. Castes included Anavil Brahmins, Leva Patidars, Marathas and a mixed group consisting of Mohammadans, Parsis, Gujaratis and Maharashtrians. Care was taken to include, as far as possible, only unrelated individuals in this study.

Bhils were investigated from Mirakhedi and Limkheda villages near Dohad in the Panch Mahal district. The other four tribal groups were studied from the Surat District. Dhodias were taken from Puna village in Mahuwa taluka; Dublas, from Varad village of Bardoli taluka and Hansapore village of Navsari taluka; Kolis also from Hansapore village and Naikas, from Mandir village of Navsari taluka and Lavacha village of Pardi taluka. Anavil Brahmins were collected from Navsari taluka of Surat District and Leva Patidars of Charotar were collected from Nadiad of Kheda District. Marathas and the mixed group, from Bombay, also were included in this study.

Sickling test on the red cells was done on the spot using freshly prepared 2% sodium metabisulphite as described by Daland and Castle.[6] Care was taken to read the results within half-an-hour to avoid false positive reactions. The samples were preserved in ice and were again tested in the laboratory.

As an independent check, some of the samples were run by paper electrophoresis using horizontal pattern apparatus described by Smith and Conley.[7] Hæmolysates were prepared from saline washed red cells, freed of cell stroma and diluted to 6-8 g.%. Filter-paper (Whatman 3 MM) strips, 5 cm. × 38 cm., were soaked in Veronal buffer pH 8·6 with an ionic strength of 0·05 and blotted dry. A streak of hæmolysate was applied to the strip of paper which was supported between siliconized glass plates. Electrophoretic runs were made at 20-22° C., 200-220 volts, 3-5 ma, for 10-12 hours. Two known samples, one containing a mixture of hæmoglobin A (normal adult) and S (sickle-cell) from a case of sickle-cell trait and the other only hæmoglobin A (Lehmann and Sukumaran[8]) were used as controls in every run.

The results of the sickling test are given in Table I.

TABLE I

Caste or tribe	No. of persons tested	No. of persons with sickling	Percentage incidence
Bhils ..	206	32	15·53
Dhodias ..	107	22	20·56
Dublas (Talavia) ..	211	20	9·48
Kolis ..	51	0	0·0
Naikas or Naikadas	90	20	22·22
Anavil Brahmins ..	53	0	0·0
Leva Patidars ..	150	0	0·0
Marathas ..	201	0	0·0
Mixed group ..	222	0	0·0

Out of 94 samples that showed sickling, 78 were suitable for electrophoresis. All these samples showed mobilities similar to the mixture of hæmoglobin A and S used as control thus confirming the presence of sickle-cell hæmoglobin in the heterozygous form. 191 samples of Dublas that did not show sickling were also run for electrophoresis. All showed a pattern similar to hæmoglobin A, ruling out the presence of any other abnormal hæmoglobin in this sample.

The results thus showed a remarkable variation in the incidence of sickle-cell trait among these tribal groups varying from practically no incidence among Kolis to more than 20% among Dhodias and Naikas. There was a low incidence of R_0 (cDe) chromosome among these tribes. The only other study in India, reported in detail so far, is from Nilgiris where incidence of sickle-cell trait ranged from 4% to as high as 34%, with a low incidence of R_0

chromosome. It is hoped that the present finding will be of anthropological and medical interest.

The authors are grateful to Dr. V. R. Khanolkar, Director, Indian Cancer Research Centre, for his encouragement during the course of this study. They are thankful to Dr. N. M. Purandare, Professor of Pathology and Bacteriology, Seth G. S. Medical College, for his interest in this investigation. Thanks are also due to Shri P. G. Shah and Shri J. B. Naik of the Gujarat Research Society and Shri Sukhdeobhai Trivedi and his associates of the Bhil Seva Mandal for their helpful co-operation in collecting the samples from the various tribes.

Human Variation Unit, P. K. SUKUMARAN.
Indian Cancer Res. Centre, and L. D. SANGHVI.
Dept. of Pathology and Bacteriology, G. N. VYAS.
Seth G. S. Medical College,
Bombay-12, *July* 24, 1956.

1. Lehmann, H. and Cutbush, M., *Brit. Med. J.*, 1952, i, 404.
2. Büchi, E. C., *Anthropologist*, 1955, **1**, 25.
3. Dunlop, K. J. and Mozumdar, U. K., *Ind. Med. Gaz.*, 1952, **87**, 387.
4. Foy, H., Brass, W. and Kondi Athena, *Brit. Med. J.*, 1956, i, 289.
5. Bhatia, H. M., Thin, J., Debray, H. and Cabanes, J., *Bull. de la Societe d'Anthropologie*, 1955, **6**, 199.
6. Daland, G. A. and Castle, W. B., *J. Lab. Clin. Med.*, 1948, **33**, 1082.
7. Smith, E. W. and Conley, C. L., *Bull. Johns Hopkins Hospital*, 1953, **93**, 94.
8. Lehmann, H. and Sukumaran, P. K., *Man*, 1956, **56**, 95.

ANATOMICAL DEFECTS OF THE REPRODUCTIVE ORGANS IN CATTLE FOUND IN UTTAR PRADESH

ACCORDING to Williams[1] the reproductive system of most monsters are conspicuously abnormal, but fortunately in these cases the basic monstrosity excludes possibility of reproduction. Genital aberrations, in otherwise normal animals, are of great economic importance. Earlier diagnosis by breeders and veterinarians would considerably reduce the expenses in the maintenance and feeding of these animals. The still greater importance of these defects lies in the fact that most of them are hereditary.[1-4,6] In a country like ours where we do not like to kill cows or her progeny, it is still more important that we do not breed and increase undesirable and defective progeny. With this objective in view, while conducting palpation of the genital organs per rectum or carrying out clinical examination of the genitalia in bulls used at Artificial Insemination Centres, the following observations were made:

(*a*) *Cryptorchidy.*—The testicles of domestic herbivora migrate from the abdomen into the inguinal canal before birth. Williams[1,5] found this condition most common in horses and swine. He also observed 75% of cryptorchidy in the progeny of a monorchid ram. According to him it is definitely hereditary, and he attributes it to a genetic defect in the spermatozoa or ova, and not to some developmental disturbance in intra-uterine life. A Hariana calf with one testicle was seen at a bull rearing farm in Mathura District. In Sahiwal breed, a similar case was observed in another farm in Barabanki District. It was a farm-bred bull. On clinical examination, the left testicle, the cauda, caput and corpus epididymis appeared to be normal. On the right side, a small testicular bulb, the size being approximately $2'' \times 1''$, appeared to be present near the inguinal canal. The size of the seminal visicle on both sides was found normal.

Eriksson[6] found that the sexual gland hypoplasia seen in cattle in Sweden is hereditary and is due to an autosomal recessive gene with incomplete penetration.

(*b*) *Anatomical Deviation in the Position of the Two Testicles.*—In a buffalo-bull, stationed at an artificial insemination centre in Partabgarh District, it was found that the two testicles were not present on the sides but one was anterior to the other as is normally seen in the canine species. The bull is otherwise very active, has a good sex-libido and gives good quality semen.

The male calves born from this bull have the same appearance. The scrotum is notched in the middle and is not circular (bag-like). Upto March 1955, 486 inseminations have been made out of which 310 pregnancies have taken place. The abnormality has been observed in about a dozen male calves. There might be many more in the different villages and as the calves are still young, the owners may not have observed it. In the female calves, examination per rectum is not possible at this stage but it may be that corresponding anatomical abnormality may also be present in them too.

The above observations indicate that at least in males the condition is hereditary.

(c) Underdevelopment of the Genitalia in a Hariana Heifer.—A Hariana heifer, aged 3½ years, said to have never come to œstrum in quite good health, was seen at Hapur Gaushala. The vulva and vagina were very small. The heifer speculum (Russian model) could not be introduced as the vagina was too small. Examination per rectum showed a small corpus uteri, unrecognisable cervix. The ovaries could not be palpated.

The udder was very small with very little glandular tissue and with rudimentary teats. The heifer was born as a twin-mate to a male calf. As cases of 'Free martin' are quite common in cattle this might be one of such cases in which the female sex organs have not developed owing to the male sex-hormones circulating in the blood during intra-uterine development. This would be permanently sterile.

This case of 'free martin' is being recorded for the first time in India.

(d) Non-Development of Mullerian Ducts in Sahiwal.—A farm-bred heifer, aged 5½ years, in good health and body development was examined. The vulva and vagina were well developed and were like as in multipara. On examination per rectum the cervix, corpus uteri could be detected with great difficulty. The horns were very thin. The tubal area of the genital organ develops from the Mullerian ducts in the female and evidently it appears that this has not developed in this case.

The udder had 5 teats out of which one was well developed and surprisingly yielded milk. The other four were very small.

The malformations of the genital organs of a minor nature are sometimes seen during general clinical examination. They may or may not affect fertility but are definitely not normal structures. In the West, where big slaughter-houses exist, extensive anatamo-pathological studies can be made while, in our country, we have to depend on clinical findings and, therefore, our data would always indicate a much lower incidence of such malformations.

Cryptorchid; anatomical deviation of the testicle in the buffalo-bull; monsters; genital defects in the female are regarded by many as isolated, meaningless curiosities but many such anatamo-physiological defects are hereditary. Teratological defects not only constitute an inferiority in the individual, but are transmitted to the progeny. To avoid such defects, breeding animals should therefore be carefully selected.

MAHENDRA PRATAP JOHARI.
Regional Sterility Centre,
U.P. College of Veterinary
Science and Animal Husbandry,
Mathura, *January* 30, 1956.

1. Williams, W. L., *Diseases of the Genital Organs of Domestic Animals*, Ithaca, New York (U.S.A.), 1943.
2. —, *Cornell Veterinarian*, 1936, **26**, 1.
3. —, *Ibid.*, 1931, **21**, 25.
4. McPhee, Russell and Zeller, *J. Heredity*, 1931, **22**, 295.
5. Warwick, B. L., *Ohio Agr. Expt. Station, Bull*, 480, 1931, Citation from Williams, Ref. 1.
6. Eriksson, K., *Hereditary Form of Sterility in Cattle*, Lund, 1943.
7. Gilmore, O. Lester, *J. Dairy Science*, 1949, **32**, 71.

CONDITION FACTOR IN SOME FISHES OF LUCKNOW, UTTAR PRADESH

THE relation of the length and weight in fishes follows approximately the cube law relationship expressed by the formula $K = 10^5 W/L^3$, in which W is the weight in grammes, L the length in millimetres and K a constant. This constant K fluctuates and Heincke[1] proposed the use of the factor as the index of the well-being of the fish. This factor is often referred to as the "Condition factor" or the "Coefficient of condition", and is used to indicate suitability of an environment or to compare fish from one lake or area with a general average for an entire region. Khan and Hussain,[2] and Jhingran[3] have made observations on the weight-length relationship in some fresh-water fishes but condition factor studies do not appear to have been pursued so far in India.

The data are derived from 850 specimens of four different species of adult fishes, *viz.*, *Cirrhina reba* (Ham.), *Amblypharyngodon mola* (Ham.), *Rohtee cotio* (Ham.), and *Oxygaster bacaila* (Ham.), obtained from the La Martiniere Lake, Lucknow, during 1954 to 1955. The fishes were preserved in 5% to 8% formalin and at a later date measured as to total length to the nearest millimetre and weighed to the nearest centigram. Preservation in formalin, however, raises the condition factor by increasing the weight and decreasing the length of the fish. No attempt has been made to adjust the factors for this increase since the same order of change prevails in both fresh and preserved fish as observed by Hoar.[4]

Average values of the condition factor of the four species of fish were calculated for the

different months during 1954-55. Four definite periods were recognised in the values of the condition factor of these fishes as seen in Fig. 1, the values being highest during winter (January, February and March), and

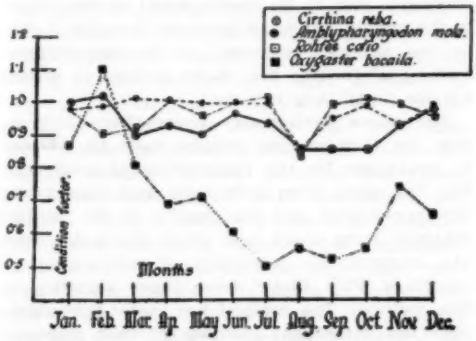


FIG. 1. Variations in the condition factor of *Cirrhina reba*, *Amblypharyngodon mola*, *Rohtee cotio* and *Oxygaster bacaila*, in the different months during 1954-55.

slightly lower in the pre-monsoon period (April, May and June). During the pre-monsoon period the adult fishes are generally sexually mature, hence an increase in the condition factor. Differences in the variations in the environmental conditions as observed by Das and Moitra[5] also influence increase in the weight of the fish. In the monsoon period (July, August and September) most of the fishes spawn and become spent thus recording a decline in the condition factor. In the post-monsoon period (October, November and December) the fishes gradually improve in condition. The extent of this rise and its duration depends on the local feeding conditions. *Cirrhina reba*, a herbivorous fish, has the slowest recovery. *Amblypharyngodon mola* shows sharper recovery although it is a herbivorous fish, while *Rohtee cotio* and *Oxygaster bacaila*, both omnivorous fishes, record steep rise in the condition factor. In similar studies by Menzies[6] for the salmon of Scotland, there is in general a sharp spring improvement followed by a falling in condition during late summer and autumn. He concludes that the rise is due partly to an increase in the size of the fish and partly to seasonal improvement. These differences are not only related to differences in spawning periods of the fishes, but also to differences in available food and environment.

The author wishes to acknowledge his gratitude to Dr. S. M. Das for his guidance and constant encouragement during the course of the work and to the Scientific Research Committee, U.P., for a research grant.

Dept. of Zoology, S. K. MOITRA.
The University, Lucknow,
May 15, 1956.

1. Heincke, F., *Die Beiteilung Deutschlands a. d. internat. Meeresforschung*, Jahresber, 1908, **74-5**, 67.
2. Khan, H. and Hussain, A., *Proc. Ind. Acad. Sci.*, 1944, **20 B**, 224.
3. Jhingran, V. G., *Proc. Nat. Inst. Sci.*, 1952, **18**, 449.
4. Hoar, W. S., *J. Fish. Res. Bd. Canada*, 1939, **4**, 441.
5. Das, S. M. and Moitra, S. K., *Curr. Sci.*, 1935, **24**, 417.
6. Menzies, W. J. M., *Fish Scotland Salmon Fish*, 1921, **2**, 1.

A FERMENTATION PROCESS FOR THE PRODUCTION OF QUALITY FISH MEAL

MATHEW, NAIR AND RAMAKRISHNAN[1] observed that the fishy odour of shark liver oil is completely removed as a result of agitation of the oil with fermenting milk for 36 hours. This suggested the possibility of preventing the development of rancidity in fish meals by the treatment of the raw material with fermenting milk.

A number of experiments were conducted in which minced flesh from different fishes was treated separately with small quantities of buttermilk (after defatting) and the final products examined for their keeping qualities. Surprisingly enough, the analyses of the different samples of the fish meals showed that under certain conditions the oil content of the fish is considerably reduced in the final product, and that the meals did not develop the characteristic rancid odour of the untreated fish powder even after keeping in glass bottles for over 9 to 10 months. The details of the process are as follows:

The fish after removal of viscera and scales is minced well in a meat mincer. The required quantity of defatted buttermilk (about 1 oz. to 6 lb. of minced flesh) is added and the whole material is mixed thoroughly with the minimum quantity of water. The pH is maintained between 4·5 and 5·0 and the temperature is raised to about 30-35° C. by keeping the container in the sun or in lukewarm water. The reaction is allowed to continue for about 4 hours with constant stirring. The material is pressed afterwards in cloth bags and dried in the sun.

The final product is found to have a better appearance than the simple sun-dried and pow-

dered sample and is as good as the products obtained from the wet reduction process.

For detailed study and comparison, meals were prepared by the following three different methods: (1) simple sun-drying and powdering, (2) cooking, pressing, drying and powdering, and (3) fermenting, pressing, drying and powdering. Five different species of fish have been tried, *viz.*, *Sardinella albella*, *Sardinella gibbosa*, *Ilisha brachysoma*, Rays and shark (*Carcharinus* sp.). Samples of fish meal obtained from these species were analysed for their mositure, fat, total and water-soluble protein contents. The results are presented in Table I.

TABLE I
Analysis of fish meal

Name of fish from which meal is prepared	Moisture %	Fat %	Total-N %	Protein (N × 6·25) %	Water-soluble protein % of total-N
Sardinella albella *a*	6·1	9·8	..	..	..
do .. *b*	7·0	3·7	13·30	83·13	5·0
do .. *c*	6·4	4·1	14·35	89·68	15·6
do .. *d*	8·3	1·4	..	..	..
Sardinella gibbosa *a*	6·4	10·1	11·90	78·38	17·6
do .. *b*	9·8	6·0	13·50	84·38	6·2
do .. *c*	5·8	6·2	14·00	87·50	10·0
Ilisha brachysoma *a*	7·2	7·1	..	..	..
do .. *b*	6·8	4·1	12·95	80·94	6·0
do .. *c*	9·0	3·4	13·30	83·13	10·5
Shark .. *a*	7·2	1·8	14·00	87·50	18·5
do .. *b*	5·3	0·8	14·94	93·38	6·8
do .. *c*	5·8	0·6	15·08	94·25	18·2
do .. *b*	8·4	0·6	14·78	92·38	5·9
do .. *c*	9·2	0·3	14·50	90·63	14·2
Ray .. *a*	9·2	3·2	..	..	..
do .. *b*	9·9	1·3	14·35	89·68	9·8
do .. *c*	7·6	2·2	14·35	89·68	16·1

* *a*—Simple sun-dried and powdered; *b*—Cooked, pressed, dried and powdered; *c*—Fermented, pressed, dried and powdered, *d*—Solvent extracted, dried and powdered.

It may be seen from the table that in samples obtained by the fermentation method there is a considerable reduction in the oil content, both in the oily varieties such as *Sardinella albella* and *Sardinella gibbosa* and the non-oily fishes like sharks and rays. The rate of reduction of fat is quite comparable to that obtained in the cooking process although it is not found as efficient as solvent extraction. From the values for the protein contents of the fish meals it must be presumed that the treatment does not materially affect the amount of protein. It is quite likely that in the fermentation process the bacterial action induces some sort of zymolysis of the fat component of the fish flesh and it is disrupted and simplified without impairing the proteins.

The water-soluble protein contents of the fermented samples also provide some interesting results. The percentage of this component in the product obtained from the fermentation process is seen to be nearly equal to that found in the simple sun-dried product. As against this, in the product prepared by the conventional method of cooking the major portion of water-soluble proteins is removed.

The above preliminary observations indicate that the fermentation process may be adopted to advantage for the preparation of good quality fish meal from both fatty and lean fishes. The appearance and the quality of the product obtained from shark and other cheap fish flesh also suggest the possibility of preparation of odourless 'Fish Flour' from these varieties by this method. The method has many advantages over the traditional methods in that elaborate cooking arrangements and the use of costly solvents are avoided, ensuring at the same time a good quality fish meal. But since the fat in the fish is believed to be disrupted as a result of the reaction it may be best suited in cases where the recovery of oil from the flesh is uneconomic.

My grateful thanks are due to Dr. N. K. Panikkar for guidance and encouragement.

Central Marine Fisheries Research Station, Mandapam Camp, *August* 6, 1956.

V. KRISHNA PILLAI.

1. Mathew, P. K., Nair, P. V. and Ramakrishnan, T. A., *Proc. Ind. Sci. Cong.*, 1949, Part III, Abst., 101.

PSEUDOMONAS TUTICORINENSIS N. SP., A MARINE DENITRIFYING BACTERIUM*

THE occurrence of a large number of denitrifying bacteria from sea-water and other marine materials in India has been recorded,[1-4] and the activities of some of them described.[2] It has been pointed out that these bacteria may symbiotically and in other ways reduce nitrates to nitrites and gaseous nitrogen and thus cause loss of nitrogen from the seas. The low nitrate content in restricted areas of our sea-waters and their fluctuation are attributed to the number and activity of denitrifiers.[5]

During a study of the bacterial groups in marine environment, a culture was obtained from marine sand, off Tuticorin, inoculated into

* Published with the kind permission of Director of Industries and Commerce (Fisheries), Madras.

cellulose enrichment medium, which produced gas from nitrate. A description of this culture is given below.

Morphology.—Rods, straight, actively motile with a single polar flagellum, $0{\cdot}4\mu \times 0{\cdot}6\mu$, single and in pairs, gram negative, non-spore-forming. *Cultural Characteristics*: Sea-water—Agar colonies—white, opaque, smooth, circular, entire, raised, with translucent periphery; Agar stroke—abundant, white butyrous, glistening turning cream-coloured with age. *Biochemical Properties*: Very heavy turbidity and abundant slimy sediment in broth; acid from glucose, sucrose, galactose, xylose and arabinose; does not ferment lactose, mannitol and glycerol. Brom-cresol-purple milk unchanged but with 3% NaCl a soft coagulum was produced and turned alkaline; gelatin not liquefied; indole and H_2S (peptone iron agar) not produced; starch partially hydrolysed; nitrate in broth reduced to nitrites and to gaseous nitrogen; (0·5% KNO_3 completely reduced in 6 days); denitrification also with lactate as hydrogen donor; grows in the presence of 0·005% hyd xylamine but not in 0·025%, without production of gas; grows and proliferates with only 200 p.p.m. organic matter (peptone) but requires 1,500 p.p.m. for denitrification. No growth in fresh-water media; no fluorescent pigment produced; aerobic; facultative. Good growth at 37° C. *Note*: All media were made up with 'aged' sea-water.

This culture differs from any that have been described in literature,[6,7] and reviewed by us elsewhere.[2] It is therefore considered a new species of marine pseudomonas and is named *Pseudomonas tuticorinensis* N. sp. The culture is in deposit in American Type Culture Collection (ATCC 12230) and in N.C.T.C., Poona.

Fisheries Technological Station, Kozhikode-1, *June* 16, 1956.

A. Sreenivasan.
R. Venkataraman.

1. Venkataraman, R. and Sreenivasan, A., *Proc. Ind. Acad. Sci.*, 1954, **40**, 161 and unpublished data.
2. Sreenivasan, A. and Venkataraman, R., *J. Gen. Microbiol.*, 1956, **15** (2) (in press).
3. Sreenivasan, A., *Curr. Sci.*, 1956, **25**, 92.
4. Velankar, N. K., *Ind. J. Fish.*, 1955, **2**, 96.
5. Jayaraman, R., *Ibid.*, 1954, **1**, 345.
6. ZoBell, C. E. and Upham, H. C., *Bull. Scripps. Inst. Oceanogr.*, 1944, **5**, 239.
7. Bergey's *Manual of Deterministative Bacteriology*, 6th Ed., 1948. Williams and Wilkins, Baltimore, U.S.A.

OCCURRENCE OF NODAL GALLS ON SUGARCANE

The occurrence of 'Galls" on cultivated sugarcane was first reported from Hawaii.[1] Pemberton[2] investigated the possible relationship of the attack of the stalk mite *Tarsonemus spinipes* Hirst with the formation of nodal galls. Martin (quoted by Wismer[3]) observed that stem galls could develop on healthy plants of certain varieties of sugarcane when inoculated with insect extracts. In India, Narasimha Rao[4] has found occurrence of malformations at the growing point in *Saccharum spontaneum* L. caused probably by a dipteran fly.

During the course of observations on a sugarcane ratoon varietal test at the Government Agricultural Research Station, Rudrur, Hyderabad State, the authors noticed galls in three of the four varieties under test. The percentage of affected stalks as calculated on the basis of observations on 50 stalks taken at random for each variety were approximately: Co. 471—22%, Co. 475—19·5%, Co. 522—6·5%, Co. 624—0·0%. The gall formation occurred in the month of October when the crop was ten months old. The galls are irregular in shape and mostly found in the upper half of the stalk in the root band region. Invariably, the growing point of the affected cane is killed and the stalk remains stunted. The galls when kept in cultures, yielded a species of microlepidopterous moth (*Eucosmidæ* ?) which is still under identification. The caterpillars which are delicate and pale white in colour bore into the nodal region of a cane to form galls each containing 20-25 of them. While rearing in the culture, most of the caterpillars come out of the galls. Pupation takes place in the galls only.

Further observations showed that planted crop of variety Co. 744 was affected during the months of September-October 1955 while the other varieties in the test were free from galls.

This is presumably the first record of insect galls on a cultivated variety of sugarcane in India.

Our sincere thanks are due to Sri. K. L. Khanna for encouragement.

Govt. Agri. Res. Station, Rudrur, Nizamabad Dist., Hyderabad-Deccan, *June* 14, 1956.

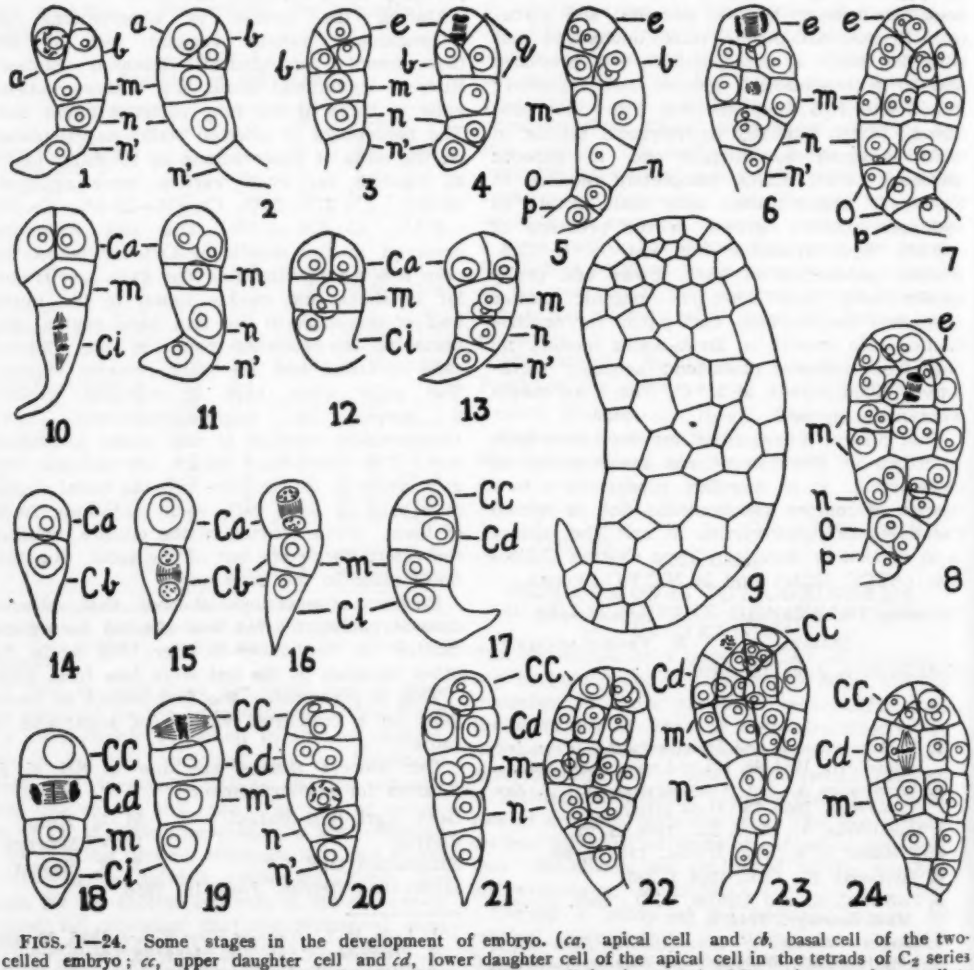
M. Q. Khan.
D. V. Murthy.
S. K. Sastry.

1. Lyon, H. L., *Hawaiin Plant Record*, 1926, **30**, 492.
2. Pemberton, C. E., *Ibid.*, 1929, **33**, 152.
3. Wismer, C. A., *Proc. 8th Cong. Int. Soc. Sugar cane Tec.*, Barbados, West Indies, 1953, 945.
4. Narasimha Rao, G., *Curr. Sci.*, 1954, **23**, 1, 29.

VARIATIONS IN THE DEVELOPMENT OF PROEMBRYO IN *UTRICULARIA CŒRULEA* L.

In recent years sufficient literature has accumulated regarding embryo development in the Lentibulariaceæ. Crété,[1] in his recent paper, has briefly reviewed the earlier work on the embryogeny of this family. Johansen[2] has recorded that the development of embryo in the Lentibulariaceæ corresponds to the Polemonium variation of the type Chenopodiad. Reayat Khan,[3] working on *Utricularia flexuosa*, has concluded that the development of embryo conforms to Catalapa variation of the Onagrad type. Besides this, he has figured several variations in the development of the embryo. Crété[1] has come to the conclusion that the embryo development of *Pinguicula leptoceras* is of the sub-arche type of the *Capsella*. While the development of the embryo in *Pinguicula* appears to be of a definite type, it is not certain in *Utricularia*.

In *Utricularia cœrulea* the early development of embryo shows some variations. Broadly, at the tetrad stage, the proembryo can be classified into three types: (i) the tetrad of the



FIGS. 1—24. Some stages in the development of embryo. (*ca*, apical cell and *cb*, basal cell of the two-celled embryo; *cc*, upper daughter cell and *cd*, lower daughter cell of the apical cell in the tetrads of C_2 series *a* and *b*, daughter cells of the apical cell, cut off by an oblique wall in the tetrad of B_2 series; *m*, intermediate cell of the tetrad; *ci*, lower cell of the tetrad; *n* and *n'*, daughter cells of *ci*; *o* and *p*, daughter cells of *n'*; *e*, epiphysis cell and epiphyseal tissue; *q*, quadrant). All Figs., × 485, except Fig. 9, × 243.

series A_2 (Fig. 10), (ii) the tetrad of the B_2 series where the apical cell *ca* has an oblique vertical wall (Fig. 1), and (iii) a linear tetrad of the C_2 series (Figs. 16, 17).

Thus in the same species, *Utricularia cœrulea*, there are three types of proembryonal tetrads. In the tetrad of B_2 series a definite epiphysis is organised (Figs. 2-8). But, it is difficult to specify what are the essential stages of development starting from these various fundamental forms. The Figs. 10-13 correspond to the tetrad of A_2 series. Besides these, there are more stages of embryo development evidently derived from tetrads of B_2 series (Figs. 1-8) and series C_2 (Figs. 14-24). In these two cases, the apical cell *ca*, like in a normally constituted embryo, might give rise on one hand to initials of the stem surface and on the other the cotyledons *sensu stricto* (but the cotyledons reduced). But, the major portion of the hypocotyl would come from some intermediate cell of the tetrad. However, further stages of differentiation were obscure. The mature embryo appears to be an undifferentiated mass whose cells are smaller at the apex and larger towards the base (Fig. 9). Even the differentiation of root cap could not be made out (Fig. 9).

Such variations in the development and organisation of embryo are not uncommon. Crété[1] has stated that the embryogenesis of the Lentibulariaceæ is consistent with the sub-archetype of the *Capsella*. However, in the development of the embryo of *Pinguicula leptoceras*, he has observed some variations or anomalies like, in the organisation of quadrants, oblique partitioning during dermatogen differentiation, etc. But, there are some late variations which do not modify the fundamental laws of embryogeny, while in *Utricularia cœrulea* they are precociously seen in the second generation, and serve to connect the several types which differ radically from one another.

It must be concluded that in the Lentibulariaceæ, *Pinguicula* presents tetrads according to A_2 series and that the development of the embryo is connected, undoubtedly, to the sub-archetype of *Capsella*. But, in *Utricularia* the development is very complicated. Souèges,[4] while dealing with the "Embryogenic system", classifies such forms which have anomalies under "Irregular types". According to him these irregular types form a category in which are arranged on the one hand, the embryonic forms which are developed according to the general rules but are variable with the individual plants that have been examined; on the other are the forms in which it is not possible to determine the regularity in the least. The development of the embryo in *U. cœrulea* follows the first category and shows variations. Of the three variations mentioned for *U. cœrulea*, the A_2 and C_2 series are of frequent occurrence in the same species and in the same locule of the ovary. The exact causes for such variations in the same species are not known. But, Souèges[4] has attributed "Ancient hybridisation" as the cause for variations observed in embryogenesis.

Grateful acknowledgement is made to Prof. P. Crété, Faculté de Pharmacié, Universite de Paris, France, for criticism and suggestions.

Dept. of Botany, Central College, Bangalore-1, *July* 30, 1957.

S. B. KAUSIK.
M. V. S. RAJU.

1. Crété, P., *C.R. Acad. Sci., Paris*, 1936, **242**, 1063.
2. Johansen, D.A., *Plant Embryology, Chronica Botanica*, 1950.
3. Reayat Khan, *Phytomorphology*, 1954, **4**, 80.
4. Souèges, R., "Embryogénie et classification." 3e fasc. (partie spciale)," *Première periode de Systeme*, Paris, 1948.

A MALE STERILE MUTANT IN *N. TABACUM*

MALE sterility of species crosses of Nicotiana was reported in *debneyi-tabacum* and *megalosiphon-tabacum* crosses by Clayton[1] and in Langsdorfii-Sandaræ cross by Smith.[2]

Raeber and Bolton[3] reported a case of intravarietal male sterility occurring in populations of American Joiner, a flue-cured variety of *N. tabacum*, grown from aged seed at Kutsaga in 1953-54 and 1954-55 seasons. The proportion of male sterile to normal plants observed in the 1954-55 season was about one to twelve.

A similar male sterile plant was found at this Institute in 1952-53 in a 2 acre crop of Harrison Special, also a flue-cured variety of *N. tabacum*. It was slightly undersized and had smaller leaves. The floral branches of this plant were bare (Fig. 1) but for a few undersized capsules, flowers (Fig. 2) and buds. The ground below the plant was strewn with withered flowers complete with calyx and ovary. The corolla tubes were narrower and lobes smaller and less pink than normal. The style was about one-fourth inch longer than the stamens. The anthers were deformed and did not dehisce. Anther section showed a few pollen grains. The filaments were normal in this plant but in some of the male sterile F_2 segregates (reported below) some of the stamens were replaced by petaloid structures (Fig. 3). This condition was observed in the

early flowers and was almost absent in the late ones. Fig. 2 shows the floral parts in

FIG. 1

FIG. 2 FIG. 3

detail. Pollen from dissected anthers could not fertilise either the flowers of the same plant or of other plants in hand pollinations. There was, however, no difficulty in setting when these abnormal flowers were used as females in crosses with other plants.

A small quantity of seed was available from the open pollinated capsules in 1952-53. Since the plant was in the centre of a two-acre crop of Harrison Special it was assumed that it resulted from the natural cross of the male sterile plant by pollen from normal plants of Harrison Special. A cross was also made with Golden Harvest, another flue-cured variety. Both the F_1s, each of 12 plants, raised in 1953-54 consisted only of plants normal in floral structure and fertility. Both segregated into male sterile and normal plants in the subsequent F_2 generation in 1954-55. Five plants out of 59 in the progeny derived from open pollinated seed and 5 out of 60 in that from the cross with Golden Harvest were male sterile. In the F_3 generation (1955-56) the segregations were as given in Table I.

TABLE I

Showing segregation in F_3 families

Families derived from the open pollinated male sterile plant		Families derived from the cross with Golden Harvest	
Monogenic (3 : 1)			
Normal : M.S.		Normal : M.S.	
11 : 3		50 : 11	
11 : 3		27 : 4	
11 : 5		26 : 6	
22 : 5			
Total ..	55 : 16	Total ..	103 : 21
Digenic (15 : 1)			
21 : 2		23 : 1	
55 : 5		11 : 1	
		34 : 1	
		13 : 2	
Total ..	76 : 7	Total ..	81 : 5
Apparently* non-segregating			
7 : 0		22 : 0	
9 : 0		7 : 0	
19 : 0		13 : 0	
		10 : 0	
		12 : 0	
		34 : 0	
		35 : 0	
		34 : 0	
		33 : 0	
		67 : 0	

* On account of the small numbers it is difficult to be sure that they breed true.

It will be seen from Table I that though the number of families as well as the number of plants in each family is small, segregations satisfying both monogenic as well as digenic ratios occurred in both the crosses. In the case of the natural cross, even the proportion of the two types of segregating and the true breeding families, which should theoretically be 4·8 monogenic : 1·8 digenic and 2·4 non-segregating, is fairly satisfactory. The cross with Golden Harvest, however, does not very well conform to expectation. Firstly, the normal plants in the monogenic segregation are in excess of the expected number in each of the families, and secondly, the proportion of the three types of families is very unsatisfactory. The causes for such performance remain to be investigated. However, the F_2 segregations and the general behaviour of the F_3 families would indicate that the male sterility described in this case is heritable and digenic.

The fact that flowers on the male sterile plants contained almost no viable pollen, made

it possible to utilise them in studying the amount of natural cross-pollination with fairly good precision. For this purpose, counts of flower scars and set capsules were taken on 14 plants in which the first flower opened from 30th January to 29th February. Both the counts were taken first on 20th March and secondly on 16th April. The percentage of natural cross-pollination was worked out by dividing the number of capsules set by the total number of flowers borne (number of scars *plus* number of capsules). The following indications emerge from the data:

The total number of flowers borne were 2,494 of which 183 set capsules. This would indicate natural cross-pollination having occurred at an average rate of 7·3% during the season. But, on the five plants which started flowering earlier, i.e., upto the middle of February, the amount of natural cross-pollination was less (5·5%) than on the late-flowering ones on which it was 8·9%. On the earlier flowering plants, the percentage rose from 3·7% to 13·8% later in the season while that on the late-flowering ones the corresponding rise was from 4·2% to 18·8%, as judged from the differences in counts on the two dates. The high increase late in the season is probably due to the fact that the flowers of the male sterile plant, being less showy, are able to attract more insects at that time, when the normal plants have almost finished flowering. The above data would indicate that the amount of cross-pollination during the main period of flowering is at least about 4%.

Central Tobacco Res. Institute, Rajahmundry, *June* 30, 1956.

N. R. Bhat.
T. Krishnamoorthi.

1. Clayton, E. E., *J. Hered.*, 1950, **41**, 170.
2. Raeber, J. G. and Bolton, A., *Nature*, 1955, **176**, 314.
3. Smith, H. H., *Genetics*, 1951, **36**, 576.

A NEW BACTERIAL LEAF-SPOT ON *PHASEOLUS TRILOBUS*

Leaves of *Phaseolus trilobus* Ait., the three-lobed kidney bean, were found to be affected by a bacterial leaf-spot at the Agricultural College Farm, Poona, in June 1954. The disease appears as minute water-soaked spots on the lower surface of leaves. With the progress of the disease, the spots enlarge in size, become angular and chocolate-brown in colour. In nature, only the leaves appear to be infected. The study of the various characters of the pathogen indicates that even though it is closely allied to *Xanthomonas phaseoli* (Smith) Dowson, it differs from the latter in certain characters besides being highly host specific. It is, therefore, proposed to assign to it a new name, *Xanthomonas phaseoli-trilobi* sp. nov., whose technical description is as follows:

Short rods, single, rarely in chains, 0·87 × 1·44 μ, monotrichous; gram negative; capsulated; non-spore-former; not acid fast; colonies on potato-dextrose agar plates are circular with entire margins, smooth, shining, convex, colour Baryta yellow (Ridgway), no distinctive odour; gelatin liquefied; starch not hydrolysed; casein digested; milk slowly peptonised; litmus reduced; hydrogen sulphide and ammonia produced from peptone; nitrate not reduced; M.R. and V.P. tests negative; acid but no gas from dextrose, maltose, sucrose, lactose, glycerol; no growth in salicin and dextrin; optimum temperature for growth 27-29° C., thermal death point 53° C., pathogenic to *Phaseolus trilobus* Ait. only, producing spots on leaves. Found at the Agricultural College Farm, Poona.

Fuller details will be published elsewhere.

Plant Path. Lab., Agric. College, Poona, *July* 16, 1956.

V. V. Bhatt.
S. G. Abhyankar.
M. K. Patel.

PYTHIUM CATENULATUM MATTHEWS CAUSING SUGARCANE SEEDLING ROOT ROT

Among the fungi isolated from sugarcane seedlings killed by root rot were a few isolates which were identified as *Pythium catenulatum* Matthews. This organism which has few records about its occurrence abroad was described from America.[2] It has been reported once in India by Balakrishnan who found it growing on decaying vegetable matter and parasitizing *Spirogyra*.[1] He did not observe the sexual stage and based his identification on the characters of the asexual stage alone.

The sugarcane organism is characterised by sporangia which consist of slightly inflated hyphæ or irregular swellings germinating by the liberation of 20 to 30 reniform zoospores (6-8 μ × 6-10 μ) from a vesicle formed at the end of a narrow emission tube. A number of catenulate, spherical to pyriform vegetative bodies occur on the hyphæ, 12-22 μ in diameter, and these germinate by germ tube. The sexual stage is produced on maize meal agar but not on a number of other natural and synthetic media including boiled carrot slices found favourable

for this by Matthews.[2] Oogonia are terminal or intercalary, smooth, thin-walled, 20-35 μ in diameter; antheridia monoclinous or diclinous upto 12 (usually 6) distributed more or less at equal distances around the oogonium, clavate, crook-necked, in narrow apical contact with the oogonial wall; oospores single, smooth-walled, plerotic, 16-28 μ in diameter (Fig. 1). Germination of the oospores was not

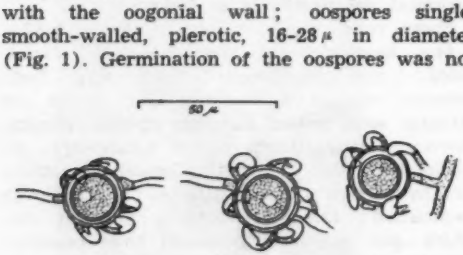


FIG. 1. *Pythium catenulatum*. Sexual Apparatus.

secured. Observation of the sexual stage confirms the existence of this species in this country.

Inoculation of sugarcane seedlings, two to four weeks old with zoospore suspensions or by raising sugarcane seedlings on sterilized soil in which a sand and oat culture had been incorporated resulted in deaths due to root rot. Controls were healthy and the pathogen was reisolated from affected plants. Seedlings over three months old could not be infected. To the knowledge of the writer there does not appear to be any previous record of this organism parasitizing any of the higher plants.

Grateful thanks are due to Mr. N. L. Dutt, Director of this Institute, for encouragement.

Sugarcane Breeding Inst., K. V. SRINIVASAN.
Lawley Road P.O.,
Coimbatore, *May* 28, 1956.

1. Balakrishnan, M. S., *Proc. Indian Acad. Sci.*, 1948, **28B**, 27.
2. Matthews, Velma, D., *Studies on the Genus Pythium*, Univ. North Carolina Press, 1931, p. 47.

SPONTANEOUS VARIEGATED CHIMAERA IN *DIANTHUS CHINENSIS* L.

SPONTANEOUS occurrence of variegated chimæras[1] has been of late rather common involving different species of plants grown for horticultural purposes in the Botanical Gardens of this College. The species involved were cultivated variety of *Dahlia* (half the capitulum on one branch bearing white flowers—the other half being coloured as normal), *Helianthus annuus* (parts of two of the leaves developing yellow sectors) and *Dianthus chinensis*. The present communication reports the detailed study of a variegated chimæral branch of *D. chinensis*, which arose as a sport in a homogeneous population of this horticultural variety.

Of the nine branches arising in a cluster from one seedling of *D. chinensis*, only one branch developed variegated chimæra. On close examination it was seen that the basal part of this branch was green all round, but 3 cm. above the ground-level, from the first node, a very narrow yellowish sector appeared which widened its breadth gradually upwards upto the extreme apex. It may be seen from Fig. 1

FIG. 1

that the albino sector stands out prominently beyond the first node of the affected branch and there is close parallelism in the production of green or albino branchlets as they arise from the green or albino sectors. The first branchlet arising from the green sector is normal green without even a streak of albinoness whereas the other two branches arising from the second and fourth node are purely albino types without a streak of greenness. Leaves which have their origin partly in both the sectors produce albino and green segments of the lamina in strict conformity with the points of origin. When a flower is borne on the albino branch its bracts and sepals are also albino and the petals are faintly coloured. But a flower terminating a partly albino branchlet develops corresponding green and albino portions. Therefore, on the chimæral branch were produced branchlets, leaves and flowers of 3 categories: (*a*) all parts green and normal, (*b*) partly green and partly albino sectors, and (*c*) all parts albino.

Pure albino and normal flowers were selfed and bagged and their seeds collected. It was seen that flowers on the green branch produced on an average 45 seeds each, two flowers on the albino branchlets produced only 2 and 6 seeds respectively, despite the fact that 95% of the pollen grains in the albino flowers stain-

ed red with acetocarmine. The viability of these seeds has not yet been tested. If the 8 seeds from the albino flowers do at all germinate, it is expected that these will produce albino seedlings which may die out at an early stage.

Transverse sections of the branch and branchlets and leaves at various positions showed interesting features in the development of chloroplasts. The branches showed sectorial (Fig. 2) pure albino and pure green chimæral

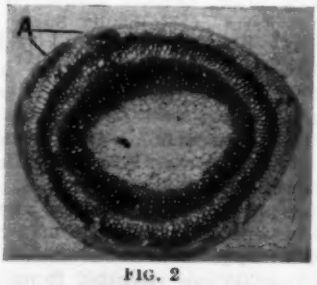


FIG. 2

pattern in the development of chloroplasts. The albino sectors of leaves which were crumpled externally were devoid of chloroplasts—although palisade and spongy tissues in the green sector of the same leaf contained normal chloroplasts. Pure albino leaves were smaller than the pure green ones. In this respect our findings are in agreement with those of Weiss[2] and Tandon and Vasil.[3]

Obviously, the production of the variegated chimæral branch amidst a cluster of nine branches from a seedling of *Dianthus chinensis* was induced by environmental conditions at a very young stage when branch buds were being differentiated and that it arose as a 'sport' or bud mutation involving only a sector of the apical meristem. This claim may be substantiated by the occurrence of sectorial chimæra in *Dahlia* flower under similar conditions of the environment. The mutation in *Dianthus* not only inhibited the development of normal chloroplasts primarily,[2,4] but also appreciably reduced the seed output, when the flowers were selfed.

Ravenshaw College, Cuttack, *May* 20, 1956.

C. M. BASTIA.
G. PANIGRAHI.

1. Bastia, C. M. and Panigrahi, G., *Proc. Ind. Sci. Cong.*, 1956, Part III, 257.
2. Dermen, H., *J. Hered.*, 1950, **41**, 325.
3. Tandon, S. L. and Vasil, I. K., *Ind. Journ. Hort.*, 1954, **11** (1), 10.
4. Weiss, F. E., *J. Roy. Hort. Soc.*, 1940, **65**, 213.

A THERMOSTATICALLY CONTROLLED MINIATURE GLASS-HOUSE

IN physiological studies in the uptake of metabolites and consequent tissue changes in plants under the influence of antibiotics in the soil, the need for a constant temperature miniature glass-house became urgent. One such was constructed and is described here (for the benefit of workers in this and related fields of research)

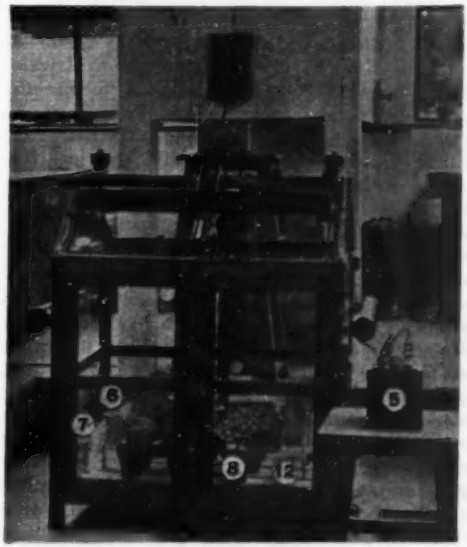


FIG. 1

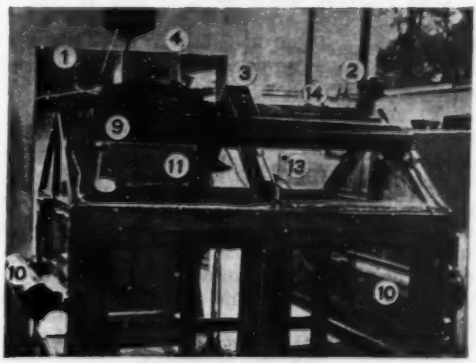


FIG. 2

1 and 2—Thermostats; 3—HVS relay; 4—battery charger; 5–6-volt battery; 6 and 7—200-watt heating units (4 nos.); 8—plants; 9, 10—four tube lights; 11—fan; 12—slatted floor board with wire-gauze support; 13—thermometer; 14—¼" air-holes on ridge.

as it has been found a most useful acquisition in experimental physiology.

The chamber is a wood and glass structure (Figs. 1 and 2) measuring 40" long, 28" wide, 45" at the ridge and 35" at the door with sloping roofs. Two sunvic dry thermostatic controls (Type TS. 3) connected in parallel through a HVS relay (Type F 102/3) operate four 200-watt dry heaters mounted on the floor in four corners protected by asbestos sheet baffles preventing direct radiation of heat on to plants. A miniature rubber blade 6-volt autofan is mounted on the roof operating on a 6-volt floating battery circuit (with a trickle charger unit). This fan keeps a feeble air circulation, as any large agitation would result in an exaggerated transpiration and vitiation of results. A number of ¼" holes, drilled into the wooden ridge, allows sufficient air inlet for the fan. Four tube lights are mounted on the outside of the cabinet, two on the sides and two on the roof with suitable reflectors and these are of known lux value to enable the investigator to undertake photoperiod work also (for instance, a miniature chamber covered with black cloth can easily be pushed into the cabinet for dark phase observations).

The chamber has been in continuous commission for months at varicus temperature levels and is not only trouble-free but also maintains accurately ± 0·2° C., a couple of degrees above the atmospheric air temperature. The chamber is compact, takes as many as 16 fair-sized potted plants (4" pots) and can be used with advantage inside air-conditioned rooms, should the investigator desire to have lower temperatures in warmer parts of this country. Other details of the construction are clear from the labelled photographs. It is obvious that the chamber can be put to multifarious uses in plant physiological laboratories (including tissue culture work) and also for enzyme work in microbiological laboratories.

This chamber was constructed out of a generous grant to one of us (T. S. S.) under the personal grants scheme for research workers of the Ministry of Education, Government of India. We offer our thanks to Shri V. Mahadevan of the United Automobiles for help in designing, building and standardizing the equipment.

T. S. SADASIVAN.
(MISS) L. SARASWATHI-DEVI.
(MISS) C. B. SULOCHANA.
University Botany Lab.,
Madras-5, *July* 30, 1956.

SOIL APPLICATION OF 2, 4-D TO INCREASE SUGAR IN CANE

THE present authors, using the technique of large-scale experimentation involving milling tests at the factory, have recently reported[1–3] consistent increase in the sugar content of cane from foliar treatment with 50 p.p.m. solution of 2, 4-D (sodium salt). This note reports the results of preliminary work undertaken with the object of assessing the effect of applying the hormone through the soil.

The trial was conducted in duplicate in a large block under October planted B.O. 10 at Haripakhri Farm of Majhaulia Sugar Factory, each of the treated and control plots being about half-an-acre in area. The treatment consisted of flooding the basal region of sugarcane clumps with a 0·5% solution of a proprietary formulation containing 33% amine salt of 2, 4-D at the time of interculture in March and earthing up in June. On each occasion, 180 gallons of the solution were applied per acre, corresponding to a dosage of 3 lb. of the hormone. The plots were harvested in March (age 17 months) and subjected to milling tests at the factory. The results presented in Table I would indicate that soil application of 2, 4-D increases sugar content of cane and estimated recovery by 2·57-3·05 and 2·74-3·30 units respectively.

TABLE I
Showing mill test data

Particulars	I		II	
	Treated	Control	Treated	Control
Sugar % cane	16·87	14·30	16·85	13·80
Fibre % cane	14·98	15·72	14·42	14·87
Purity crusher juice	91·06	89·92	91·26	90·16
Purity mixed juice	88·09	85·41	87·40	85·79
Mill extraction %	95·73	94·68	96·26	92·40
Estimated recovery	14·80	12·06	14·65	11·35
Improvement in estimated recovery	2·74	..	3·30	..

The treatment appears to have no appreciable effect on the yield of cane, average figures for the treated and control plots being 549 md. and 522 md. per acre respectively. Similarly, growth criteria at harvest are also not significantly affected.

It can therefore be tentatively concluded that soil treatment with a dilute solution of an amine salt of 2, 4-D in two doses of 3 lb. of the hormone per acre applied at the time of interculture and earthing up brings about a large increase in the sugar content of cane without appreciably affecting its growth or yield. Fur-

ther studies are in progress with a view to fully examining the possibilities of this method.

The authors wish to acknowledge the assistance rendered by Sri R. D. Sahi, Analytical Assistant, in the course of this work.

Central Sugarcane Research Station, Pusa, *June* 1, 1956.

A. S. CHACRAVARTI.
D. P. SRIVASTAVA.
K. L. KHANNA.

1. Chacravarti, A. S., Srivastava, D. P. and Khanna, K. L., *Indian Sugar*, 1955, **5**, 171.
2. —, *Curr. Sci.*, 1955, **24**, 316.
3. —, *Proc. Internat. Soc. Sugarcane Tech., 9th Cong.*, 1956.

NEMATODE GALLS ON A GRASS *DICANTHIUM ANNULATUM*

THE grass, *Dicanthium annulatum*, grows as a weed in fields, but mostly as a fodder on the bunds and also in the fallow lands. During August 1955 galls were collected on the leaves of this grass at Rajendranagar Farm and since then from many places.

Galled grasses occur in patches which gradually increase in size, and the attacked leaves may drop off. Galls are pinkish in colour when fresh, changing to dark purple later. These bulge out on both sides of the leaf, one portion being larger than the other. They are formed mostly on the leaves, but leaf-sheaths are no exceptions and in one case a gall was found on the stem. When the leaves are young and the attack is severe, they shrivel and dry up. The galled leaves may twist or join leaf-blades. Galls are found to occur mostly in the portions near to the soil. Usually these occur separately but sometimes may coalesce together and give a knotty appearance to the leaves (Fig. 1). When fresh galls are pressed pinkish liquid oozes out. The number of galls per leaf varies from one to seventeen.

Galls are small and are of the cynipid type. They are usually round with elliptical outline, hard when touched and are found on either side of the mid-rib; when cut open, a chamber full of nematode eggs, larvæ and adults is seen. The wall forming the cavity is 2-3 layers thick. A very small pore is seen on a mature gall, through which the larvæ escape and reinfest healthy leaves. Galls are found in nature from the beginning of the monsoon till the grass dries up in the summer. Galls formed on healthy leaves emerging from a rhizome of an infected plant (perhaps some larvæ might have been lying on the stem). The upper and lower portions of the gall measure 2·2 mm. to 4·1 mm. × 1·66 mm. to 2·77 mm. and 1·1 mm. to 1·7 mm. respectively.

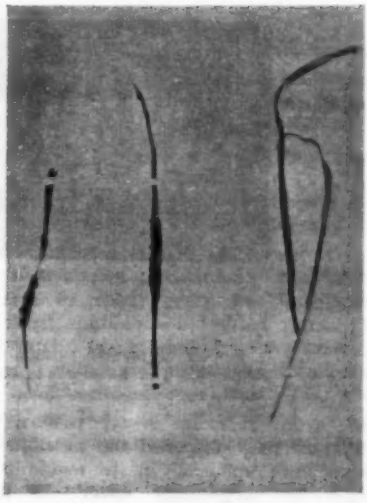


FIG. 1
Galls on grass, *Dicanthium annulatum*.

Hundreds of eggs and larvæ and a limited number of adults, usually 2-4 in each sex, are found in a gall. Nematodes are glistening white and sometimes the females become plumpy and appear opaque. When the eggs hatch, the larvæ coil into a mass, and when put in a drop of water they begin to move fast. Eggs are large and range from 93-102 μ × 37-37 μ; the average being 95 μ × 37 μ. More than 200 eggs have been found in a single gall.

Males are slender and shorter and measure 1,018 to 1,277 μ × 56 to 74 μ. Females are large and stumpy and measure 925 to 2,387 μ × 37 to 148 μ. Larvæ vary in size between 426 and 1,018 μ and 14 to 56 μ. The nematode causing galls on the grass, *Dicanthium annulatum*, has been provisionally identified as *Anguina* sp. (Family: Tylenchidæ).

Grateful acknowledgement is due to Dr. Syed Vaheeduddin, for facilities, to Sri. D. V. Subba Rao, for help in collecting the material, to Dr. M. R. Saxena, for identifying the host, and to Dr. S. N. Singh and Sri. Dass for identifying the nematode.

Main Experimental Farm, Rajendernagar, Hyderabad (Dn.), *July* 6, 1956.

D. BAP REDDY.

METAMICT HEMATITE

IN the course of some investigations on low grade uranium ores it was found that the hematite in it gave an extremely weak and

(*a*)

(*b*)

FIG. 1

Powder diffraction pattern of (*a*) original metamict and (*b*) heat-treated hematite. The lines due to the impurities magnetite (M) and quartz (Q) are marked.

diffused front reflexion X-ray pattern shown in Fig. 1 *a*. This suggested the possible occurrence of the mineral in a metamic state (absence of long-range order of lattice). The mineral sample was therefore heated to 1,000° C. for 48 hr. in an atmosphere of pure nitrogen. The sharp pattern obtained from this heated sample is shown in Fig. 1 *b*. An analysis of this revealed the presence of hematite as a primary constituent with some magnetite (~ 10%) and silica (~ 10%).

The occurrence of hematite in the metamict state and its reconstitution are established as can be clearly seen in Figs. 1 *a* and 1 *b*. A detailed account will be published later.

Chemistry Division, M. D. KARKHANAVALA.
Atomic Energy Establishment,
Bombay, *August* 4, 1956.

A LARGE OVERTHRUST STRUCTURE NEAR DEBIPUR (BARAKAR), WEST BENGAL

THERE is a well-defined overthrust of length over 3 miles, seen at a distance of about 6 furlongs west of Debipur (Longitude 86·6° E. and Latitude 23·4° N.). This huge overthrust has brought the older gneisses above the younger shales of Talchir stage over a low-angled thrust plane not found in previous literature.

There are many evidences to confirm the presence of this overthrust structure. The direction of movement was N.E.-S.W. and is well-marked on the quartzites of this area, which show a foliation N.W.-S.E. direction. This feature is not seen in the quartzites anywhere else in Barakar. Huge piles of quartz pieces are seen scattered over a large area in the vicinity of the overthrust structure. Owing to the thrusting and the shearing, the Talchir shales have become splintery, slaty and crushed. The gneisses which have their original dip in the north-east direction are caused to dip in the south-west direction over the Talchir shales. One of the most convincing evidences is the occurrence of pieces of gneisses in the Talchir shales. These forcefully included or rather snatched pieces are of various shapes, rounded and angular, and these must have got caught up in the shales which provided a plastic medium during the movement. These shales containing the gneiss pieces cannot be mistaken for Talchir boulder beds, as we studied the boulder beds earlier in the neighbouring areas, which contained varieties of rocks, basic, acidic, unaltered felspars, glaciated and striated pieces, etc. Nevertheless, one very interesting and curious feature is the igneous rock appearance of the Talchir shales. Nowhere was a piece of fossil found in them, and the mode of occurrence too resembles that of altered traps. It is very difficult for us, at this stage, to say anything definite regarding this curious rock. It may, however, provide a basis for further investigations on the Talchirs of other areas.

Dept. of Geology, D. N. RATH.
Banaras Hindu University, S. RAMARATNAM.
May 5, 1956. S. B. KAR.

REVIEWS

High Polymers—Polymer Processes. Edited by C. E. Schildknecht. (Interscience Pub.), 1956. Pp. xvii + 914. Price $ 19.50.

Quite a few books have appeared on high polymers during the past two decades; but the general tendency has been to lay the stress exclusively either on the fundamental or the applied aspect. The volume under review is a notable exception, and combines both the aspects admirably and may be said to bridge the gap between theory and practice.

In the first five chapters running to nearly 200 pages, recent developments of fundamental interest related to addition polymer processes have been dealt with—polymerizations in bulk, suspension, emulsion, and solution with a number of illustrated diagrams of the reactors, etc., given. The next chapter on ionic polymerization, written by the editor, is brief, but very illustrative with reference to preparation of butyl rubbers. Chapters on polyamides and polyesters by Bannerman and Magat and on condensation with formaldehyde by Suen are also short but understandable in view of the number of monographs that have already appeared on the subject. Treatment on fibres and films is cursory. Recent developments, especially in the technology of epoxy resins and polysulfide polymers, have been nicely summarized in two separate chapters. A series of subjects essential to a plastics engineer and technologist, like paste technique, adhesives, stabilization of polymers, latex techniques, etc., have been brought together for the first time in this volume.

Compounding and processing of rubbers and resins by Garvin of Goodrich Chemical Co. has received a treatment with a bias for a theoretician. Processes like film casting, spread coating, dip coating, block skiving, calendering, etc., could have been more illustrative. But the chapter forms an exhaustive catalogue of various types of processing with various plastics. The last two chapters on 'polymer reinforcement and spinning and drawing of fibres' have been dealt with exhaustively with a series of illustrations, fabrication techniques like bug moulding, molding of glass fibre, impregnation, fibre drawing, spinning processes, etc.

The bulk of the material given in the book will be of great interest and value to the plastics technologist. To the polymer chemist engaged in research, the volume under review is an eye-opener to the multifarious industrial aspects of high polymer technology.

M. SANTHAPPA.

India's Mineral Wealth. By J. Coggin Brown and A. K. Dey. (Oxford University Press, London), 1955. Pp. 760. Price Rs. 30.

This well-known publication, which was unprocurable for many years, has now emerged in its third edition in a revised form. It has been brought up to date in information and statistics. India is rich in mineral resources and it has been conceded that hardly the surface deposits have been worked in many cases. The assessment of the country's potential reserves has been made in some cases and will be the subject of detailed investigations in the near future.

The first part of the book deals with the mineral fuels and details of geology, occurrence and classification are recorded. In an exhaustive description of metallic ores, the salient features of the origin, occurrence and association of the precious metals, minerals and ores of iron, non-ferrous and light metals are discussed together with the all too important atomic minerals. Attention has been drawn to the less familiar metals and their ores. The next part deals with materials used in construction such as building stones, slates and marbles, ceramic raw materials, glass sands, minerals used in industry as ochres, corundum, phosphates, the micas anl many others. A separate section on the precious and semi-precious stones found in India together with their uncommon counterparts would be found valuable. The last part deals with water supplies and soils. There is an exhaustive bibliography to help readers and an appendix recording mineral production for the three years ending 1953.

There are several maps of the geology of India and adjoining countries and mineral-bearing areas in these countries. There are many plates and graphs recording production of the different commodities. The statistical value of the book lies in the great many tables which are given for almost every mineral cited in the book.

The authors deserve considerable praise for compiling such a useful publication which

should be an asset to institutions and individuals interested in the country's mineral wealth.

N. R. SRINIVASAN.

Antibiotics Annual, 1955-56. Edited by Henry Welch and Felix Marti-Ibanez. (Medical Encyclopædia, Inc., New York, N.Y.), 1956. Pp. xvii + 994. Price $ 10.00.

Those who have gone through the two previous issues of the *Antibiotics Annual*, must be impatiently waiting for the Third Annual Number covering the proceedings of the Third Annual Symposium on Antibiotics held in Washington, from November 2nd to 4th, 1955. The present volume contains 150 reports contributed to the symposium and in addition, there are extremely instructive reports of the three panel discussions on the important subjects, "Long-Term and Prophylactic Use of Antibiotics", "Penicillin V", and "True Significance and Real Incidence of Reactions Following Clinical Use of Antibiotics". There are 12 papers on Penicillin V which has now shot up into limelight after five years of dormancy, and reports on 12 new antibiotics. It is impossible to make even a passing reference to all the significant findings reported and it would suffice to say that the volume is a mine of information and a "must" for all researches on antibiotics to read, though the bias is on the clinical side. There is the sound advice to the clinician: "The ideal thing would be to use the 'umbrella' of antibiotics only in real pathological storms, and not for passing summer showers". But the manufacturers of antibiotics would prefer the use of the 'umbrella' even against suspected drizzles!

There are contributions from authors from 15 countries, India included; but conspicuous is the absence of any from Britain, USSR and the East-European countries. This will probably be remedied in subsequent years; as the message of President Eisenhover says: "Such international co-operation and understanding goes far in improving the health of all the people. A world mentally and physically healthy will be a peaceful world". The following passage significantly enough also occurs in a fascinating article by Marti-Ibanez: "Health, like peace, will have to be created in the future through a peaceful and benevolent co-existence with germs and political opponents, independent of chemotherapies or atomic bombs. Disease prevention by the creation of conditions that will improve physical and mental health will lead to the creation of healthier mentalities and cleaner thinking....Wars are conceived in men's brains, before they are fought out on the battlefield."

K. GANAPATHI.

Treatise on Inorganic Chemistry, Vol. I. By H. Remy (translated by J. S. Anderson). (Elsevier Publishing Co.), 1956. Pp. xv + 866. Price £ 5 5 *sh.*

Remy's *Lehrbuch der Anorganischen Chemie* has been occupying a high place among the standard and authoritative text-books in advanced inorganic chemistry, ever since its first publication in 1931. It has since run into eight editions. The popularity enjoyed by this treatise is not a little due to the successful manner in which the factual material of inorganic chemistry has been systematised by fitting it into a coherent framework of thermodynamic, kinetic and structural principles.

The volume under review is Vol. I of the first English translation of Remy's treatise. Though it is based on the 7th and 8th German editions, the English edition has been made more up to date than the original, by incorporation of additional matter, especially in the chapters dealing with nuclear chemistry, transuranic elements, etc. The present volume deals with the chemistry of the elements of the 'main groups' of the periodic table, while the chemistry of the 'sub-groups' along with general topics like radioactivity, catalysis, non-aqueous solutions, etc., have been reserved for the second volume to be published.

Of the 18 chapters of Vol. I, only 9 are devoted to the discussion of the descriptive chemistry of elements and their compounds. The remaining 9 chapters deal with general topics of fundamental significance such as "The Periodic System", "Volume and Affinity", "Crystal Structure and X-rays", "Constitution and Properties", "Hydrogen Spectrum and the Structure of the Hydrogen Atom", etc. No efforts have been spared in giving as lucid an exposition as possible of the modern aspects of atomic and molecular structure. The judicious combination of chapters on descriptive chemistry with chapters on theoretical chemistry and physics is indeed an excellent idea, which brings home to the student the necessity of gaining good familiarity with modern theories for a proper appreciation and co-ordination of the factual aspects of inorganic chemistry. This mode of treatment elevates inorganic chemistry from a mere collection of facts and data to the status of a systematic and unified science. The descriptive chapters contain, besides information on

the occurrence, preparation and properties of elements and their compounds, also short notes on their analytical chemistry. The value of the book is considerably enhanced by useful appendices containing a table of atomic weights, the periodic table and a list of publications recommended for further study.

This well-got-up and well-written volume commends itself as a standard text-book for students of higher inorganic chemistry.

A. P. MADHAVAN NAIR.

Methods of Biochemical Analysis, Vol. 3. Edited by David Glick. (Interscience Publishers, New York), 1956. Pp. x + 439. Price $9.50.

Rapid advances in the field of biochemistry have been made in recent years, mainly due to development of methods and techniques for the determination of biologically important substances. The need for an authoritative collection of these methods and techniques is readily admitted. Dr. David Glick has rendered yeoman service by editing this series on methods of biochemical analysis. With the assistance of an international advisory board, he has made a judicious selection of topics so as to emphasise innovations and developments of current interest.

In the volume under review, which is the third in this annual series, a dozen methods of biochemical analysis have been described by authors who have had considerable experience in the successful adoption of these methods or techniques in different biochemical investigations. Among these, mention may be made of organic phosphorus determinations by Lindberg and Ernster, assay of thioctic acid by Stokstad and his colleagues, histamine determination by Code and McIntire, enzymic microdetermination of uric acid, hypoxanthine, xanthine, adenine and xanthopterine by Plexner and Kalckar, and the use of periodate oxidations in biochemical analysis by Dyer. In the carbohydrate field, there are two articles, one on end group analysis of polysaccharides, by Smith and Montgomery, and the other on the use of infrared analysis in the determination of carbohydrate structure, by Barker, Bourne and Whiffen. These are followed by three articles in another field, consisting of the measurement of complex ion stability by the use of ion-exchange resins, analysis of metal protein complexes and applications of metal buffers and metal indicators in biochemistry, and will be of special interest to those dealing with physico-chemical problems. The last two articles are, however, of more general interest, one on the estimation of zinc in biological materials and the second on the principles and applications of flame photometry and spectrometry. On the whole, the subjects have been well chosen, and though in the treatment of many of them, instruments of American origin have been specially mentioned, biochemists in other parts of the world will not find any great difficulty in adapting these methods to suit their own equipment. It must be emphasized that the ready availability in recent years of spectrophotometers, pure enzymes and pure strains of micro-organisms has given a great stimulus to many research workers to develop and perfect several new methods of biochemical analysis.

The get-up of the book is of a high standard which one has come to expect of Interscience Publishers. There is, in addition, an extremely useful cumulative index for all the three volumes so far published in this series.

P. S. SARMA.

Transactions of the Archaeological Society of South India, Vol. I. (Published by the Society, Madras), 1955. Pp. x + 143.

This volume of Transactions comprises eight articles, mostly lectures delivered at the Society, besides a short introduction by the President of the Society, Justice A. S. P. Ayyar, and a foreword by a former President, Dr. A. L. Mudaliyar. While the publication of the Transactions of a learned society is always to be welcomed, it cannot be said that this volume quite meets the expectations it raises. In a publication of this type, scholars look naturally for original thought and reports of fresh discoveries. From this point of view there is very little new ground taken by any of the contributors. The only partial exception is the paper on 'Some Interesting Antiquities of Tulunad' by P. R. Srinivasan; but even he draws more from books than from his own observations. The first paper 'Temple and Pyramid and Obelisk' and the last 'Origin and Growth of Religion : Indian Evidence', both by Mr. T. G. Aravamudan, attempt fresh interpretations of known data, but speculation often outruns the evidence cited. We hope that the publication of these Transactions will become a regular feature hereafter and that they will contain reports of really original papers and discoveries like the Transactions of similar learned Societies elsewhere.

K. A. N.

Books Received

Investigations on the Theory of the Brownian Movement. By Albert Einstein. (Dover Publications, N.Y.), 1956. Pp. 119. Price $1.25.

Currents in Biochemical Research. Edited by David E. Green. (Interscience Pub.), 1956. Pp. xvi + 697. Price $ 10.00.

Anatomy of the Honey Bee. By R. E. Snodgrass. (Cornell University Press, New York), 1956. Pp. xiv + 334. Price $ 6.00.

History of Analytic Geometry. By Curl B. Boyer. (Scripta Mathematica, New York 33, N.Y.), 1956. Pp. ix + 291. Price $ 6.00.

Mechanical Testing and Inspection of Engineering Materials. By J. H. Lamble. (Cleaver-Hume Press, Ltd., London), 1956. Pp. 460-98. Price 3 *sh*. 6 *d*.

Report of the Rothamsted Experimental Station for 1955. (Harpenden Rothamsted Experimental Station, Harpenden, Herts.), 1956. Pp. 255. Price 8 *sh*. 6 *d*.

CHEMICAL APPLICATIONS OF SPECTROSCOPY*

THE present volume is a very valuable and welcome addition to the series publication—"Technique of Organic Chemistry", edited by Dr. Arnold Weissberger. Like its predecessors, it is a collaborative work containing contributions from well-known experts in the respective fields.

Applications of various physical methods for the study of organic compounds have now become a routine procedure in all laboratories. In many of these methods the experimental data are easily interpreted and can be effectively utilised in the solution of chemical problems with very little of theoretical knowledge. But the case is slightly different as regards the applications of spectroscopic methods in organic chemistry. It is easy to accumulate data on the absorption spectra of organic compounds both in the ultra-violet and infra-red regions, but it is difficult to interpret them. A knowledge of the theory of spectra is essential before one could interpret the data successfully. In the present volume on the chemical applications of spectroscopy, the emphasis is therefore on the theoretical aspect. It serves as an introduction to the interpretation of the spectra of organic compounds.

The book is divided into six chapters. Most of the chapters deal with the theory of spectra and the interpretation of experimental observations. The spectral region covered extends from microwave to ultra-violet radiations. Only brief descriptions of the experimental procedures have been given, but these are supplemented by a comprehensive list of references to original papers.

Chapter I on "Introductory Survey of Molecular Spectra" has been written by Dr. W. West. It contains an account of the spectroscopic units and nomenclature and the general features of the spectra of atoms and diatomic molecules. It also contains a brief survey of the quantum mechanical description of the electronic states and the methods of atomic and molecular orbitals. This introductory chapter forms an excellent basis for understanding the spectra of more complicated molecules dealt with in the subsequent chapters.

The second chapter on microwave and radio-frequency spectroscopy has been contributed by Prof. Walter Gordy, who is a well-known authority in the field. This subject covering the spectral region from about 1 mm., bordering on the long-wave infra-red region, up to those of the familiar radio waves, has come into prominence since World War II. The development of practical methods in this branch of spectroscopy in recent years has contributed powerful tools for the study of structure of matter, beside X-rays and electron diffraction. Their potentialities as a powerful method for chemical analysis have not yet been fully exploited. Prof. Gordy gives a lucid exposition of several important aspects, such as nuclear quadrupole coupling and its relation to chemical binding, nuclar magnetic resonance and the application of microwave spectroscopy, to the analysis of substances of great biological importance such as phthalocyanine, chlorophyll, hæmoglobin, proteins and amino acids.

In Chapter III, Prof. A. B. F. Duncan presents the theory of infra-red and Raman spectra of polyatomic molecules. Group theoretical methods which are increasingly applied to the problem of molecular vibrations, their selection rules and intensities have been described and illustrated with appropriate examples.

* *Chemical Applications of Spectroscopy—Technique of Organic Chemistry*, Vol. IX. Editor: W. West. (Interscience Publishers), 1956. Pp. xxiv + 787. Price $ 15.00.

The next chapter by Drs. R. N. Jones and C. Sandorfy is on the applications of infra-red and Raman spectrometry to the elucidation of molecular structure. This chapter is the longest in the volume, reflecting the current interest of organic chemists in infra-red spectra. The most important contribution is the comparative study of the frequencies characteristic of specific groups of atoms in a number of organic molecules, which appear in the infra-red and Raman spectra. All available data have been collected, analysed, and presented in the form of tables and figures. A detailed discussion of the characteristic group frequencies has also been included. In recent years the emphasis has been on the importance of accurate measurements of intensity in the infra-red region. The authors have therefore included in this chapter a comprehensive analysis of the ideal and of the experimental conditions appropriate to such measurements.

Chapter V on the electronic spectra in the visible and ultra-violet regions consists of two parts. The first part written by Prof. A. B. F. Duncan on the theoretical aspects embodies a comprehensive treatment of the atomic and molecular orbital theories of the electronic states of molecules. The second part by Prof. F. A. Matsen contains a detailed description of the three main structural components of electronic spectra, *viz.*, the single bond, the multiple bond and the basis group and the effects due to substitution, hyperconjugation, etc., on these. A number of general topics connected with electronic spectra such as complexes, effect of change of state, colouring matters and dyes have also been discussed.

The last chapter on fluorescence and phosphorescence contributed by Dr. West contains a summary of the general features of these phenomena as observed in organic substances. The relation between rigidity, planarity, ring-closure, etc., and fluorescence has been illustrated by choosing a number of examples. An excellent discussion is also given on the explanation of Lewis and Kasha that the phosphorescent emission is due to triplet-singlet transitions and its intensity is governed by spin orbital interaction. The quantum yield of phosphorescence and the triplet levels and thermochromism are also briefly discussed.

The book thus covers practically the whole field of spectroscopy from the millimetre wave to the far ultra-violet. The theories are presented in a simple manner so as to be easily understood by non-mathematical chemists and the chapters dealing with the interpretation of data contain a number of tables and illustrative diagrams.

The principal symbols used in the book which number well over two hundred and fifty have been tabulated and presented along with their definitions under the heading "Symbol Index" at the beginning of the book. This will be very helpful to the reader. There is also the usual subject index at the end of the book. The absence of author index is rather disappointing.

This book should find a place not only in every organic chemistry laboratory but also in every laboratory where work on problems of chemical physics is carried on.

Considering the wide range of topics discussed and that too in great detail the cost of the book does not seem to be high.

R. S. KRISHNAN.

SCIENCE NOTES AND NEWS

Tandem Vande Graaff Generator

A new type of particle accelerator for study in continuous detail of the nuclear energy levels of heavy elements will be installed by Atomic Energy of Canada Limited at Chalk River early in 1958.

The new machine consists of two specially designed Van de Graaff generators placed end to end in a horizontal position, giving the accelerator an overall length of 34 ft. and a diameter of 8 ft. The 35-ton accelerator will be mounted on a rail in an L-shaped building, 150 ft. long and 60 ft. wide. The building now under construction at Chalk River is located against a hillside so that the ground on one side will act as the shielding against high-energy radiation. Thick concrete walls will shield other sides of the building. A separate building will house controls and services.

The beam of high-speed particles produced by the tandem accelerator will be focussed and deflected in a series of powerful electromagnets into an experimental area 25 ft. from the accelerators. The machine will be equipped with a switching magnet that will make it possible to shift the particle beam into any one of five

directions, depending on the type of study under way.

The accelerator will incorporate a novel method of charge exchange whereby the electric charge of a nuclear particle is changed during acceleration to very high speed, permitting the same five-million-volt potential to impart the equivalent of a ten-million-volt beam to the particle.

Essential to the operation of the tandem-style Van de Graaff accelerator is a source of negatively charged hydrogen ions. Credit for the development of such a source is due to Professor R. G. Herb and his associates at the University of Wisconsin. With Professor Herb's source, positive hydrogen ions are made negative before being accelerated into the Van de Graaff. At the half-way point of acceleration, negative ions are stripped of their excess electrons so that they can accelerate "down-hill" using the same high voltage.

Automatic Rainfall Stations in Japan

A network of robot weather stations has been created by the Central Meteorological Observatory of Japan to give timely warning of heavy rainfall in the mountains where manned observation posts would be difficult to maintain.

The equipment of each station consists of six parts: a rain-receiving unit, a meter to measure the volume of rain, a coding unit which translates these measurements into Morse Code signals, a programme clock for timing, a transmitter and a power unit which provides electricity for the mechanical operation and for the transmission. The stations have sufficient power to operate for six months unattended. From spring until late autumn the stations send out hourly signals in Morse Code recording rainfall amounts in millimeters.

Hydraulics Research at Kharagpur

Professor Otto Walch, who drew up the plans for the Hydraulics Laboratory now operating at the Indian Institute of Technology, Kharagpur, has just completed a 4-year mission to India under the UNESCO technical assistance programme.

In the new laboratory, water from a 60,000-gallon tank is pumped through seven flumes—steel troughs varying from 20 ft. to 60 ft. in length and equipped with thick plate-glass observation windows in their sides—in order to permit study of the behaviour of scale models of dams, locks, canals, and other forms of water-way construction. Delicate measuring instruments have been supplied to the laboratory with the aid of a $30,000 UNESCO grant.

Prize for Essay on Relativity

The Teyler's Foundation and the Teyler's Second Society, Haarlem, are offering jointly a prize for an essay on "The absolute relations on time and space, between actual events, as brought to light by the theory of Einstein, and the interest which the new insight concerning these might have for views in other domains of knowledge." The prize will consist of a gold medal, worth 400 Dutch florins, or, if the recipient prefers it, this amount in cash. The essays may be in Dutch, French, English, or German, and must be submitted by January 1, 1957. Further information can be obtained from the Directeuren van Teylers Stichting, Fundatiehuis Damstraat 21, Haarlem, Netherlands.

Advanced Training in Nuclear Research

The Fund for Peaceful Atomic Development, 2,000 Second Ave., Detroit 26, Mich., has published a pamphlet entitled, *Nuclear Science and Engineering Training in the United States*, listing the facilities available at selected colleges and Universities and at the national laboratories of the U.S. Atomic Energy Commission. The publication has been prepared especially for the use of students from outside the United States who are interested in graduate training in the U.S.A. The material is in summary form and is intended as a guide in the selection of institutions for advanced training.

Standard Translations of Russian Periodicals

A new expanded programme for the translation and publication of four leading Russian physics journals is announced by the American Institute of Physics with the co-operation and support of the National Science Foundation. The Journals are: *Zhurnal Teknicheskoi Fiziki* (Journal of Technical Physics), *Akusticheskii Zhurnal* (Acoustics Journal), physics articles from the *Doklady Akademii Nauk USSR* (Proceedings of the USSR Academy of Sciences). First issues of the translated journals will appear soon. The Foundation and the American Institute of Physics have already successfully collaborated in the publication of Soviet Physics —JETP, a bi-monthly translation of *Zhurnal Eksperimental noi i Teoreticheskoi Fiziki* (Journal of Experimental and Theoretical Physics), six issues of which have now appeared. In addition to the programme in physics, the Foundation is supporting translations of Russian papers in mathematics and biology; and plans for the fiscal year 1957 include the earth sciences and the engineering sciences.

Translated by competent, qualified scientists, the publications will provide all research laboratories and libraries with accurate and up to date information of the results of research in the USSR. Subscriptions should be addressed to the American Institute of Physics, 57 East 55 Street, New York 22, N.Y.

Mineral Beneficiation and Extractive Metallurgical Techniques

A symposium on the above subject is to be held on February 5-8, 1957, under the auspices of the National Metallurgical Laboratory at Jamshedpur, with the following sections: Ore-dressing and mineral beneficiation of ferrous and non-ferrous ores; Thermal beneficiation and hydro-metallurgical upgrading of ores; Pyro-metallurgical extractive techniques; Electro-metallurgical extractive techniques and Extractive techniques based on chemical metallurgy methods. Technical papers are invited from technologists and scientists for the proposed symposium. Further details can be had from The National Metallurgical Laboratory, Jamshedpur-7.

Second Congress on Applied Mechanics

The Second Congress on Theoretical and Applied Mechanics will be held in the National Physical Laboratory, New Delhi, on October 15-16, 1956. Dr. K. S. Krishnan, Director, NPL, New Delhi, will preside. The Congress is being sponsored by the Council of Scientific and Industrial Research.

Research papers contributed to the Congress will cover the following topics: Elasticity, Plasticity, Rheology; Fluid Mechanics (Aerodynamics, Hydrodynamics); Mechanics of Solids (Ballistics, Vibrations, Friction, Lubrication); Statistical Mechanics, Thermodynamics, Heat Transfer; and Mathematics in Physics and Mechanics, Methods of Computation.

Further information can be had from the Secretary-Treasurer, Second Congress on Theoretical and Applied Mechanics, Indian Institute of Technology, Kharagpur.

Monographs on Algae and Fungi

A Conference of workers on algæ was held on May 21 under the auspices of the Indian Council of Agricultural Research to consider the question of bringing out monographs on various groups of algæ. A similar Conference was also held on July 25 in regard to Fungi. Sri. M. S. Randhawa, Vice-President of the Indian Council of Agricultural Research, presided over both the conferences, and decisions were taken regarding the assignment of different topics to different authors. The following Editorial Boards were constituted. *Algæ*: Shri M. S. Randhawa (Chairman), Dr. M. O. P. Iyengar, Dr. B. P. Pal, Dr. Ram Nagina Singh, Shri Ramanathan, Dr. P. L. Anand. *Fungi*: Dr. R. S. Vasudeva, Dr. B. L. Chona, Dr. P. R. Mehta.

Dr. U. N. Chatterjee will be in charge of the general editorial work relating to these series of monographs.

Microfilm and Photocopy Service

The Indian Council of Medical Research established in 1948 two Microfilm and Photocopy Service Units, one at the Central Research Institute, Kasauli, and the other at the Tata Memorial Hospital, Bombay. Workers who desire to have microfilm or photocopy of any article are requested to communicate complete reference to the Officers-in-Charge of the Unit and the source, if known, of the Journal where it is available. The Unit will undertake to procure the journal and supply copies of articles in the minimum time possible.

Award of Research Degree

The Osmania University has awarded the Ph.D. Degree to the following candidates for thesis on the subject noted against each. *Botany*: Shri P. Nanchar Rao, "Studies on Nutritional Requirements of *Trichoconis crotalariæ* Sp. Nov. Some Parasite Fungi from Hyderabad Deccan"; Shri Abdul Rafique Zafar, "On the Periodicity and Distribution of Algæ in Certain Fish Ponds in the Vicinity of Hyderabad, India"; *Chemical Technology*: Shri Sham Rao Nandapurkar, "Studies in Heat Transfer during the Condensation of Saturated Vapours"; Shri Balbheem Rao, "Studies of Hyderabad Clays"; and Shri N. Bhojraj Naidu, "Studies on Indigenous Vegetable Oils of Hyderabad State".

1135-56. Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25.

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

Announcing the publication of :

GLOSSARY OF INDIAN MEDICINAL PLANTS

BY

Col. R. N. CHOPRA, S. L. NAYYAR & Dr. I. C. CHOPRA

(*Size:* 10½"×6"; *Pp.* xx+330) *Price:* Rs. 8 per copy, Postage extra

An invaluable compendium of exhaustive information on the occurrence, distribution and uses of Indian Medicinal Plants with an index of their chemical constituents and vernacular names.

For Copies, apply to :

The Assistant Secretary, Publications Division
Council of Scientific & Industrial Research
OLD MILL ROAD, NEW DELHI 2

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

INDIAN FARMING

Farmer's Own Magazine

Designed to serve the interests of the Indian farmers to a wide extent, **Indian Farming,** published in an attractive format, carries besides feature articles, topical notes, etc., special interviews with farmers and material for guidance of day-to-day farming operations. A popular monthly magazine for the public.

Annual Subscription : **Rs. 9** *Single Copy :* **As. 12**

Available from :

THE BUSINESS MANAGER
I.C.A.R., QUEEN VICTORIA ROAD
NEW DELHI

INDIAN JOURNAL OF AGRICULTURAL SCIENCE

Annual Subscription: **Rs. 15** **(Quarterly)** *Single Copy:* **Rs. 4**

INDIAN JOURNAL OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

Annual Subscription: **Rs. 12** **(Quarterly)** *Single Copy:* **Rs. 3**

Available from:

THE MANAGER OF PUBLICATIONS
CIVIL LINES, DELHI 8

ORGANIC CHEMISTRY

8th Revised Edition

By P. B. SARKAR, D.Sc., F.N.I.

Director of Technological Research
Indian Central Jute Committee

First Published 1942 — 8th Ed. 1955
vi+490 P. 8½×5½ — Cloth Bound — Rs. 8

"I have never found a better book on Organic Chemistry."

PROF. S. N. SANYAL
Rajendra College, Chapra

INTERMEDIATE PHYSICS

By N. N. BASU & J. CHATTERJEE

16th Edition, 1956. In Two Vols. D/D Size

Lucid exposition, up-to-date information, numerous worked out examples, all-India examination questions, and neat diagrams are the features of this standard work. Popular all over India. Covers all-India University syllabuses.

Rs. 6 *Each Vol.*

PRACTICAL CHEMISTRY

For B.Sc. Students

By B. K. GOSWAMI, M.Sc.

Prof. of Chemistry, Midnapur College

The book covers the analytical portion meant for B.Sc. students (Pass & Hons.) of Indian Universities.

Rs. 5

INORGANIC CHEMISTRY

For Intermediate Students of Indian Universities

By P. K. DUTT, M.Sc.

Prof. of Chemistry, Presidency College Calcutta

5th Revised Edition, 1954, 560 pp. Rs. 6-4

A complete course, in lucid style, with up-to-date information. The only book which will cover the all-India University syllabus.

A TEXT-BOOK OF HEAT

(for Junior Students)

8th Revised and Enlarged Edition

By DR. M. N. SAHA, F.R.S.

AND

DR. B. N. SRIVASTAVA, D.Sc.

Prof. of Physics, Indian Association for the Cultivation of Science, Calcutta

It commands a monopoly sale in India and Pakistan as the best book on the subject and fully covers the syllabuses of Indian and Pakistan Universities. Cloth Bound, Rs. 9

ELEMENTARY PHYSICAL CHEMISTRY

10th Revised Edition, 1956

By DR. SANTI RANJAN PALIT
M.Sc. (*Gold Medallist*), P.R.S. (*Cal.*)
D.Sc., F.R.I.C. (*Lond.*)

Prof. of Physical Chemistry, Indian Association for the Cultivation of Science Calcutta

The book has been thoroughly revised and made up to date. The present edition meets the requirements of Degree (Pass) students of all Indian and Pakistan Universities.

Price Rs. 6-8

TEXT-BOOK OF INORGANIC CHEMISTRY

By P. RAY, M.A., F.N.I.

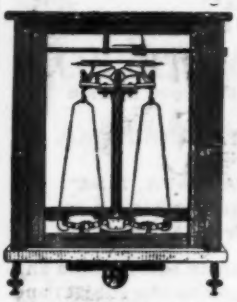
Formerly Palit Prof. of Chemistry
University College of Science, Calcutta

An authoritative text on the subject covering the B.Sc. syllabuses of Indian and Pakistan Universities. The book is expected to excel all other publications and remove a long-felt want. Combined Vol. Rs. 11

Vol. I. Rs. 6 — Vol. II. Rs. 6

H. CHATTERJEE & CO., LTD.

19, SHYAMA CHARAN DE STREET, CALCUTTA 12



KEROY
Short Beam Analytical Balance

No. K 1

A Really Dependable Balance for Degree Classes and Research Laboratories

Sensitiveness .. 1/10th mg.
Capacity .. .. 200 gm.
Price: **Rs. 300/-**

Catalogue on Request

Manufactured by:
Keroy (Private) *Ltd.*
BANARAS CANTT. :: CALCUTTA 10

Grams: 'LABFURNISH' Phone: 62761

Laboratory Furnishers
Dhun Mansion, Vincent Road, Dadar
BOMBAY 14

Available Ex-stock

- 'QUICKFIT' Interchangeable Ground Glass Joint Assemblies
- 'CAMBRIDGE' pH METERS; Bench pat. Portable pat. & Direct Reading Model & all types of Electrodes
- CAMBRIDGE DIAL THERMOMETERS
- MEMMERT GERMAN ELECTRIC OVENS
- IKA GERMAN ELECTRIC STIRRERS
- ROTOFIX ELECTRIC CENTRIFUGES
- AEROGEN PETROL GAS PLANT, Etc.
- LABORATORY GERMAN REFRIGERATORS
- GERMAN TEMPERATURE INDICATORS
- GLASSWARE 'PYREX', 'JENA' & WESTGLAS

Branch Office:
Motilal Mansion, Kapasia Bazar
AHMEDABAD 2

FLASK SHAKERS
CONSTANT TEMP. OVENS
VACUUM EMBEDDING BATHS
PRECISION THERMOSTAT BATHS
Ranges: 37° C. to 100° C. Variation ± 0·01° C.
+5° C. to + 100° C. Variation ± 0·1° C.

VARIABLE TEMP. INCUBATORS
MOISTURE DETERMINATION OVENS
NITROGEN ESTIMATION APPARATUS
ETC., ETC.

Manufactured by:
UDAY SCIENTIFIC INDUSTRIES (PRIVATE) LTD.
5, BHABANATH SEN STREET
CALCUTTA 4

THERMOSTATIC BATHS

(WATER OR OIL)

Various sizes and temperature ranges for general laboratory work. Maximum dimensions 18"×18"×12". Maximum temperature upto 300° C. Accuracy of control to within ± 0·05° C. Efficient Stirring, with glass walls on two sides for good visibility, and metal framework for strength. Switch-board and control box attached to one of the sides.

Entirely Our Manufacture

For full particulars, please write to :

THE GENERAL ENGINEERING AND SCIENTIFIC CO.

WALTAIR, VISAKHAPATNAM-3

(S. INDIA)

Technical Adviser :

Dr. I. RAMAKRISHNA RAO

M.A., Ph.D. (Cal.), D.Sc. (Lond.)

For

ZOOLOGICAL SPECIMENS

AND

BIOLOGICAL REQUIREMENTS

OF THE

LABORATORIES

AND

INSTITUTIONS

Consult :

Bombay Biological House

Dealers in Zoological Specimens

119 Hindu Colony, Dadar, Bombay 14

Established 1941

Phone 61813 Gram : PHERETIMA

All in One

INDEX

REAGENT BOTTLES

made by

Sigcol

Sole Distributors

GHARPURE & CO.

P36, ROYAL EXCHANGE PLACE

EXTENSION • CALCUTTA-1

GRAM : MEENAMO PHONE : 22-2081

VERY RELIABLE INDIGENOUS SUBSTITUTES OF GUARANTEED ANALYTICAL REAGENTS MAY BE FOUND IN

"BASYNTH"

Brand

ANALYTICAL REAGENT

Acid Hydrochloric
Acid Hydrochloric Fuming
Acid Sulphuric
Acid Nitric
Acid Nitric Fuming
Acid Acetic Glacial
Ammonium Hydroxide
Benzene
Toluene
Xylene
Petroleum Ether
Amyl Alcohol
Butyl Alcohol Etc., Etc.

Basic & Synthetic Chemicals (Private) Ltd.

P. O. Jadavpur College, Calcutta-32

—RELIABLE HOUSE FOR—

- LABORATORY GLASSWARES (Plain and Graduated)
- THERMOMETERS & HYDROMETERS (Various ranges)
- LABORATORY PORCELAINWARES & SILICAWARES
- NICKEL AND PLATINUMWARES
- WHATMAN FILTER PAPERS
- MICROSCOPES & ACCESSORIES
- BALANCES, TINTOMETERS, AEROGEN GAS PLANTS AND OTHER INSTRUMENTS REQUIRED BY CHEMICAL LABORATORIES

Contact:

UNIQUE TRADING CORPN.

51-53, Babu Genu Road

BOMBAY 2

Gram: 'UNILAB' Phone: 30011

Direct Importers

for

* LABORATORY CHEMICALS
* PHARMACEUTICAL CHEMICALS
* FINE CHEMICALS
* VITAMINS
* STAINS, Etc.

Please refer to:

B. BABULAL & CO.

"DEVKARAN MANSION"

71, Princess Street, BOMBAY 2

Gram: PETROLIUM Phone: 28465

BOROSIL

LABORATORY GLASSWARE

such as

FLASKS, BEAKERS, CONDENSERS, MEASURING FLASKS, MEASURING CYLINDERS, PIPETTES & ANY SPECIAL APPARATUS MADE TO DESIGN

and

PENICILLIN VIALS, VACCINE BULBS—WHITE & AMBER

ALL OTHER APPARATUS & EQUIPMENT MANUFACTURED TO CLIENT'S DESIGN

INDUSTRIAL & ENGINEERING APPARATUS CO. LTD.

CHOTANI ESTATES, PROCTOR ROAD

GRANT ROAD, BOMBAY 7

* JOURNAL OF

THE ZOOLOGICAL SOCIETY OF INDIA

Published bi-annually, containing original papers and reviews in all branches of Pure and Applied Zoology

Annual subscription per volume of Two issues

Foreign: Rs. 22 Inland: Rs. 20

A few back numbers are also available, subject to prior sale.

A few pages are reserved for advertisements at rates available from the Honorary Treasurer.

Reprints of a few papers of the Indian Helminthologist, the (late) Dr. G. D. Bhalerao, Indian Journal of Helminthology & Prof. Thapar Sixtieth Birthday Commemoration Volume, 1952, could also now be had from the Office of the Honorary Treasurer, Dr. B. S. Chauhan, 34, Chittaranjan Avenue, Calcutta 12, India.

All orders, remittances and communications regarding above should be addressed to the Honorary Treasurer.

BAUSCH & LOMB

DYNOPTIC

METALLURGICAL MICROSCOPES

The DYNOPTIC feature has now been extended to the new Bausch & Lomb Metallurgical Microscopes, Model DM Monocular and Model DMET Inclined Binocular.

● Uninterrupted examinations with Triple Revolving Nosepiece ● Low Position Fine Adjustment ● Versatile Operation with Focusing Stage ● Fine detail clearly visible with vertical illumination ● Maximum Light Transmission by Balcoated Optical Elements

Sole Agents

MARTIN & HARRIS (PRIVATE) LTD.

SAVOY CHAMBERS, WALLACE STREET

BOMBAY 1

ELECTRONIC MEASURING INSTRUMENTS

AUDIO OSCILLATOR

Starting with a resistance capacity Oscillator—a new kind of instrument which pioneered the resistance capacity circuit now accepted as standard for test Oscillator design, Messrs. Hewlett—Packard have steadily broadened their production schedule during the past decade and a half to cover more than 250 basic test instruments including, to list the more important types, audio oscillators, vacuum tube voltmeters, noise and distortion analyzers, signal generators, power meters, broadcast monitors, electronic counters, and a complete coverage array of waveguide and coaxial instrumentation for microwave work.

The cardinal motive working behind every—hp—instrument,—in its design, manufacture, sales and service—has been all along to incorporate into it the greatest possible usefulness, accuracy, convenience, dependability and money value and in that endeavour the makers have sought not only men of skill and experience, but men with vision and daring and a desire to better the best.

Sole Representative for India

THE SCIENTIFIC INSTRUMENT CO., LTD.

ALLAHABAD BOMBAY CALCUTTA MADRAS NEW DELHI

THE BANGALORE PRESS